AMATEUR WORK

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A RHEOSTAT.

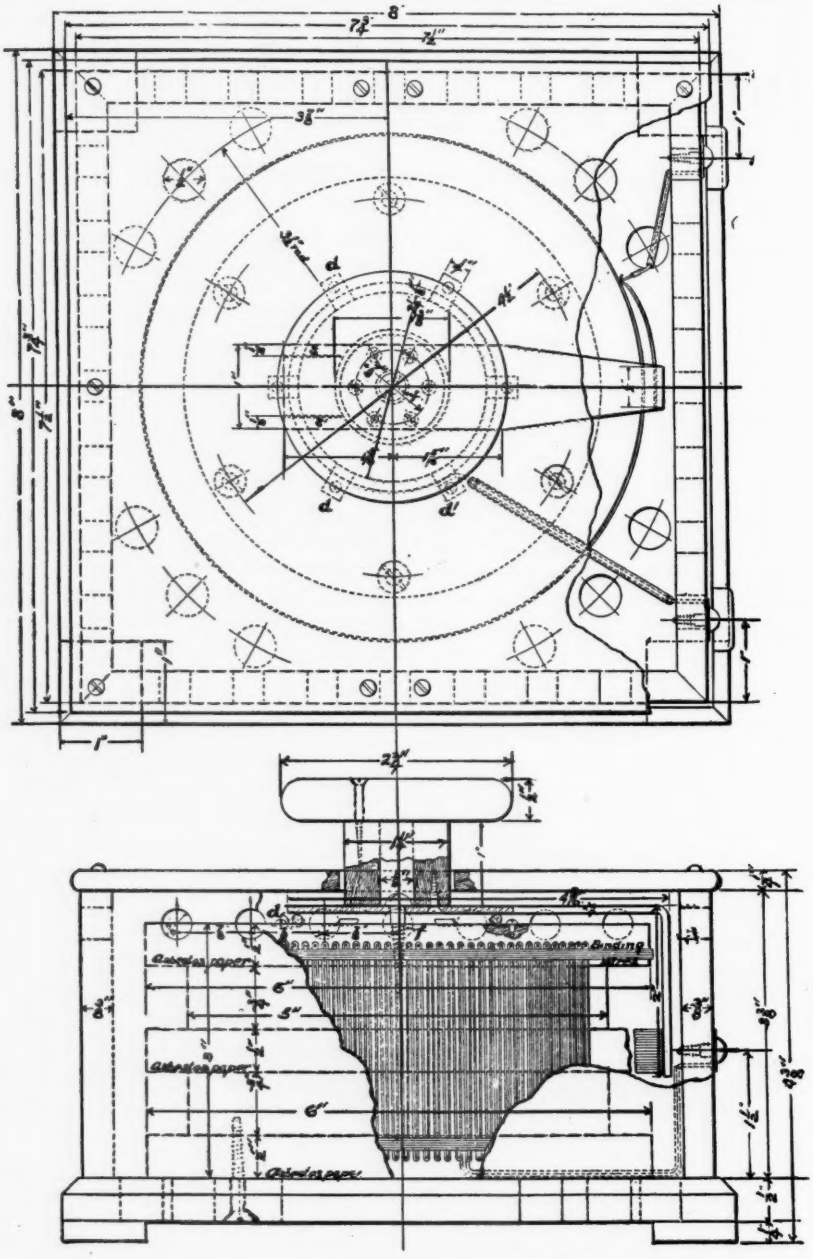
R. G. GRISWOLD.

In order that the strength of a current may be varied at will within certain limits, it is necessary to insert in series with the source of supply a variable resistance. The instrument performing this function is called a rheostat, and, as described herein, has a total resistance of about 47 ohms through 150 steps of .313 ohm each. It has a capacity of 6 amperes and should not be forced to carry more. Fig. 1 shows the instrument complete.

The spool upon which the wire is wound is made of three circular pieces of hardwood, 6 in. in diameter by $\frac{1}{2}$ in. thick, separated by two pieces 5 in. in diameter and $\frac{3}{4}$ of an inch thick. These five pieces are glued together, heated thoroughly in an oven to expel all moisture and given three coats of shellac. Prepare three $\frac{1}{2}$ in. strips of thin asbestos paper equal in length to the circumference of the 6-in. circles, or about 18$\frac{7}{8}$ in. Lay off a centre line on two of them $\frac{1}{4}$ in. from the edge and running the entire length, and divide into $\frac{1}{8}$ in. divisions. Wind these strips around the edges of the two outside disks and the unmarked one about the middle disk, cementing them in place with a light coat of shellac. The divisions of one strip should come exactly between those on the other, as shown by the dimensions in Fig. 2. Give the strips a coat of shellac.

The pins upon which the resistance coil is wound are $\frac{3}{4}$-in. wire brads, driven in the two outside disks at the eighth-in. divisions, allowing them to protrude about $\frac{1}{8}$ in. The coil is made of about 60 feet of No. 24 B. & S. soft-drawn bare German silver resistance wire, wound from one pin to the next opposite consecutive one. To facilitate the work, fasten the spool in a vise and pass the loop made at one end of the wire by soldering (*b* Fig 2) over one brad. Then, while holding the wire very taut, pass it from one brad to the other. If the turns about the brads do not lie close to them, they may be made to do so by closing them with a pair of very sharp-nose pliers, easily made by grinding the ordinary kind to an edge at the end. When the last turn has been wound on, it is fastened by soldering to a small brass clip secured to the bottom of disk *c*. Should an odd spacing of the brads bring this end to the top, fasten it there, bringing the end down through a hole in the spool to the under side where it can be brought out in a small groove. It cannot be brought from the top to the binding screw on account of the brush arm.

The protruding ends of the brads should be sent back over the wire loops, which will serve to tighten them, and the heads cut off with a pair of cutting pliers. Then carefully file the ends down until they are just above the wire and will not interfere with the arm. Wind two or three layers of shellacked thin paper strips, $\frac{1}{4}$ in. wide, over the wires just beside the brads, and on these strips wind very tightly several turns of No. 26 B. & S. spring brass wire for binding the wire loops in place in case they should become so heated as to expand enough to slip over the brads. Solder this binding wire at several places to keep the turns together and from slipping over on to the coil. Adjust the various wires where they pass the middle strip of asbestos paper until the



spaces between them are about even, and then give them a thorough coat of shellac, both at the middle strip and on the ends where they turn about the brads, where it should be well soaked in. Place in an oven and bake until perfectly dry, when a second coat should be given and baked. A piece of felt or hard cloth moistened with a little alcohol will remove the shellac from the surface of the wires where the brush makes contact, while that baked on the middle disk will hold them firmly in place where it passes over them.

The brush arm bears on a ring of $\frac{1}{8}$ in. hard brass wire, fastened to the spool by means of small clips *d*, Fig. 1, soldered to it and set in recesses in the top so that the ring has a solid bearing. One of the connecting wires for the binding posts is soldered to this ring at *d*, and carried down through a hole to a groove in the bottom and thence to the binding screw. The top of this ring should be slightly flattened and polished perfectly smooth.

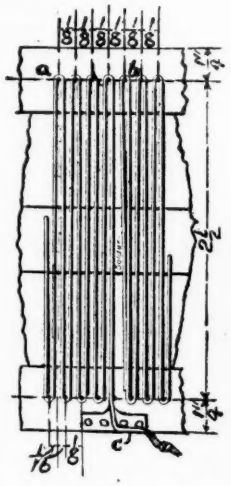


FIG. 2.

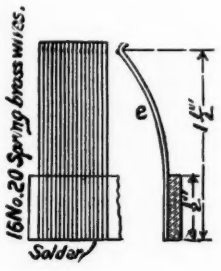


FIG. 3.

The brush arm is made from a piece of $\frac{3}{32}$ in. sheet brass, carrying at its outer end a contact brush made of sixteen pieces of No. 32 spring brass or hard-drawn copper wire, about $1\frac{3}{4}$ in. long and bent as at *e*, Fig. 3, and soldered to the arm. Arrange these pieces so that they all lie in the correct position between two pieces of thick pasteboard, when they may be grasped with the pliers and held in position while being soldered to the arm. Bend the wires as shown so that they bear firmly on the coil wires, but not hard enough to displace them when moving. The bearing surface should be polished very smooth so that the brush will slide easily.

The construction of the hand wheel and stem is plainly shown in Fig. 1. The box should be made of well seasoned hardwood and provided with the ventilating holes shown. The feet on the bottom permit of plenty of room for air to reach the bottom holes, and as the passage of the current heats the coil a circulation of air is established. After centering the spool on the bottom secure it in place with six screws, so adjusting the spool that the grain of the bottom disk and that of the bottom of the box cross at right angles to prevent warping. The top is made in two pieces so that the interior is accessible without removing the hand wheel. Bend the two sections of the brush arm *s* and *s'* slightly, to form a spring bearing on the wire ring, which will insure a firm contact and prevent binding at any part of rotation. Adjust the pressure of the arm on the ring by means of the screw *f* until it turns smoothly, connect the coil to one binding post and the bearing ring to the other, and the coil is ready for service. The box may be finished in any desirable manner.

This rheostat is not designed to carry a heavy current for any length of time, but simply to afford a means of quickly varying a resistance for experimental purposes, such as in the calibration of galvanometers where the adjustments of resistence are required in small steps.

U. S. Consul-general Patterson, Calcutta, India, reports: Lac is produced in almost every province in India, but principally in the Central Provinces, Bengal and Assam, from which the largest amounts exported are obtained. That produced in other districts is chiefly consumed in local manufactures of bracelets, rings, beads, and other trinkets worn as ornament by the women of the poorer classes, and in the manufacture of wood lacquer work, which seems to have been begun in very remote times. Some very artistic work is now done in this line.

Lac is the incrustation deposited by the lac insects on the branches of certain trees, and is collected, as a a rule, by the jungle tribes, who break off the branches on which it is deposited. In this state it is called stick lac, and is sold by the gatherers to local dealers, who sell it to the manufacturers of shellac or button lac, who put it through various processes until it becomes the lac of commerce. During the past twe years the product has been comparatively small, while the demand has largely increased. This increased demand is mainly due to the use of shellac in electrical works and, in a minor degree, for making gramaphone records. High prices may lead to the adulteration of shellac with resin, which has frequently been done but can be detected by the smell.

Renew your subscription promptly. You will not then forget it and miss a number or two.

A HAND MILLING MACHINE.

ALBERT GRAHAM.

Many, many times have models of inventions and machinery fallen wofully short of the acme of perfection indicated by the general finish of every other part, in those insignificant little keyways and splines which are so defficient when put in with a cold chisel or file.

It is not often possible, from a monetary standpoint, for an amateur to possess a milling machine, and even those that are fitted to be attached to a small lathe often cost from $60 to $75, which is nearly as much as that of the lathe.

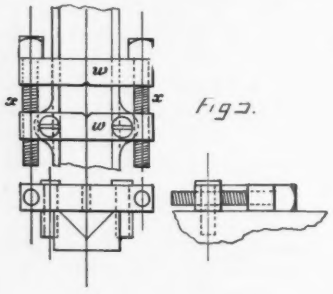


Fig 3.

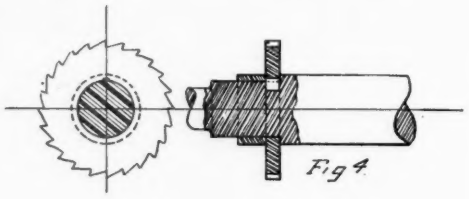


Fig 4

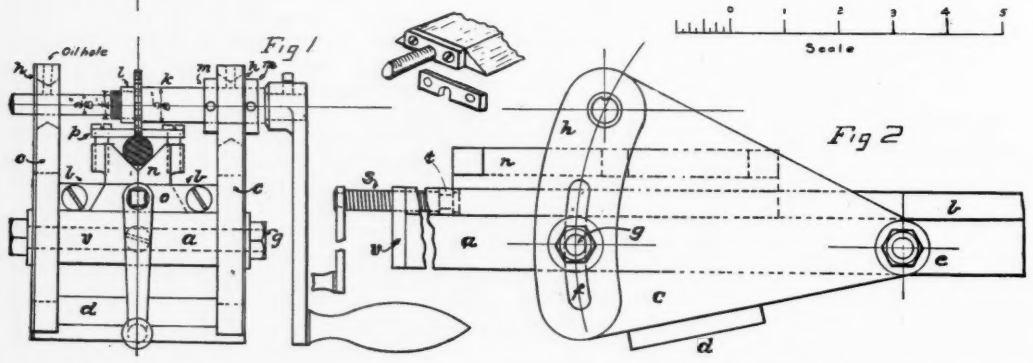


Fig 1

Fig 2

But it is possible for the amateur to construct a small machine out of ordinary materials that will do the work very well indeed. Of course gears cannot be cut on it, but small keyways, grooves in flat pieces and heads of screws, and squares on the end of circular rods or screws may be readily cut. It is to be understood that this is not intended to do the heavy work that a regular milling machine will do, for the power which can be applied is small and the feed can at best be but slow, but it will do the work intended far more rapidly than can be done by hand methods.

The base *a*, Figs. 1 and 2, is made of well seasoned maple glued together on edge. While the glue is setting, be sure that the strips are tightly clamped together. Several pins should be driven through from side to side to prevent the pieces slipping past each other when the pressure of the clamp is applied. This can be readily accomplished by boring ¼ in. holes through each piece, using the first one as a guide, and threading the strips on ¼ in. dowels. When thoroughly dry remove the clamps and plane the pieces to a true surface on each side, and making the whole at least 1 in. thick by three wide. This method of construction has the advantage of preventing warping.

The guides *b* are made of the same material, planed perfectly straight and secured to the base, *a*, by several screws placed about two inches

apart. If preferred, one strip may be glued fast and the other left free for adjustment in case of under wear. The angle between the base and the inside of the guide strip is 60°. If this work has been well done, a firm, solid base will be the the result, which will last a long time, as maple is a very hard wood of close grain, and after being well seasoned does not warp out of shape. It also has great strength.

The housings *c* are made of two ¼ in. pieces of maple glued together by the strip *d* and pivoted to the base by the through bolt, *e*. The circular slot *f* permits the cutter to be raised or lowered at will, while another through bolt *g* serves to clamp it fast. The cutter arbor runs in bearings at the upper end, as shown. Each housing is armored with a brass plate *h* which is secured thereto by small screws. The plate takes the crushing force of the through bolt *g* and prevents the washer under the nut from marring the wood. It also adds greater strength and stiffness to the housings, and the arbor passing through the holes in the brass plates that just fit, enables the strain to be transmitted in a direct line to the clamping bolt *g*.

The arbor *k* is turned from a piece of ¾ in. machine steel. An enlarged section in Fig. 4 shows the bearings afforded for the cutter. The cutter is clamped against the shoulder by means of a nut *l*, which is provided with a fine thread, say about 30 to the inch. The cutter being driven by a small key, this nut has merely to hold it against a shoulder and can, therefore, be made very light. By this construction the arbor is kept very stiff, upon which fact depends the smoothness of the cut. Two collars, *m m*, are fitted to the arbor and are adjustable, being fixed in position by the set screws shown. This provides adjustment in the direction of the arbor axis. The crank should be at least six inches long, and if the amateur so desires a fly-wheel may be added to insure steady motion.

The bearings for this arbor are made of Babbitt metal, which is very hard, and can be melted and run around the arbor when the latter is set in place, exactly parallel with the base. The bearings will then be in line and need no further work excepting the drilling of an oil hole from the top. The hole for the Babbitt metal should be countersunk from either side, and if the brass plate is tinned on the inside the bearing will be soldered to it and make a very stiff construction. When it is necessary to remove the cutter, either to sharpen it or replace it with another, the collar *m* is loosened and the arbor drawn through the bearings sufficiently to allow space between the smaller and adjoining housing, through which the cutter is removed.

The V block *n* should be made of some metal on account of the strain put upon it by the clamps in holding a piece. It may be made of either cast iron or brass, the latter being better on account of its greater toughness and ductility. The piece is small and does not permit large bosses for the clamping screws. The V may be finished with a file to a very true surface, which can be determined by laying a small mandrel in it after the surface of the mandrel has been covered with a thin layer of red lead. The high spots will be covered with the red lead, while the lower portions will not touch it at all. By repeated dressings and trials a very fair V may be made. The bottom of the V block should be filed perfectly true with the upper surface of the mandrel when it is lying in the groove. This will insure the cut being of uniform depth. Fasten this V to the wooden slide *o* by several screws passing through from the under side. A few small clamps should be made of steel to hold the pieces which are being cut, as shown at *p*.

This V, which is really the table of the machine, is fed along the guides by means of the screw *s*, which bears against a collar secured to the end of the block *o*. This screw has a groove cut in its end, as shown at *t*, which allows a horseshoe shaped slot to pass over it and thus permits the table to be fed in either direction. This arrangement is more fully shown in the small sketch directly above. This feed screw works through a threaded hole in the iron or brass plate V fastened to the end of the base *a*. A three or four inch handle should be fitted over a square on the end to provide sufficient leverage for feeding, as when the cutter is taking even a rather small chip the pressure against this screw is very great. The threads should be very much finer in pitch than ordinarily used on a ⅜ in. screw. About thirty to the inch will give a fairly fine feed and will not require too long a time to return the table after the cut is made. The handle is made a free fit on

a squared end to enable its removal in case a very long rod is being splined, in which event, the overhanging end would prevent the handle making an entire revolution. This screw may be operated by the left hand, while the right turns the cutter.

To extend the value of this machine a small vise is provided, as shown at Fig. 3, which fastens to the V by the screws similar to the one used for the clamps. The pieces *w w* are made of ½ in. square steel, either machinery or tool, the latter being preferable on account of its ability to to be hardened, and these jaws should be hardened if possible. The screws *x x* are simply $\frac{5}{16}$ in. square-headed cap screws. A small V is filed in the centre of each jaw to enable it to hold small screws and cylindrical pieces while the cutter is working on their heads or ends. By providing another boss on the side of the table V, the vise may be swung around until the jaws are parallel with the direction of feed, which is often of great advantage.

The making of cutters is not a very difficult operation. The blanks are turned to size in the lathe, the teeth filed in the periphery by hand and then hardened and tempered. Do not let the fact that the spacing may not be regular worry you in the least, for it is better that they should have irregular teeth; a cutter with regular teeth will chatter if it is given the slightest excuse, whereas an irregular spacing will tend to obviate this tendency, owing to the inability of the succeeding teeth to drop into the furrow made by the advancing or cutting tooth. This action is exactly similar to that which always occurs in a file of regular cut. Files are now generally made with an irreglar spacing which, although not readily determined by the eye, prevents that annoying chatter with its consequent rippled surface.

These drawings have not been dimensioned, but a scale has been laid down from which the measurements may be taken off. This allows the amateur to alter the machine to suit his particular needs if it should not serve as designed. The cutter and section of the arbor is just double the scale to which the machine is drawn.

Do not attempt to use cutters of much larger diameter than 1¼ in., as you will not have power to drive them with your arm. Neither will the machine stand up under a cutter much over ¼ in. in width, but it has been designed to do the ordinary run of work generally pursued by the amateur, the object in view being to give him something that will do the work and that can be built at a very low cost without the use of more than one casting, which is extremely simple to make and requires no core work.

TELEPHONE CIRCUITS AND WIRING.

ARTHUR H. BELL.

V. Telephone Troubles.

Assuming that several readers have constructed private lines, as described in the September number, a few points of instruction are here given in the clearing of trouble, which is bound to come sooner or later unless the greatest cure is taken in periodic inspections of line and instruments. The handling of telephone troubles is facilitated by a thorough understanding of the equipment in use. In a general way, however, it is likely that certain defects and faults will predominate, and herewith is given a few of the most common of these difficulties, with suggestions as to their origin and quickest methods of locating.

Cannot ring or receive a ring. Line or generator circuits open.

Can hear but cannot be heard. In such cases the trouble is usually with the battery or transmitter circuit. A careful examination of all connections therewith should be made.

Weak ringing of bells. Loose connections, bad joints in line or imperfect connections at terminals of line. Bell armature adjustment may be defective.

Hearing bad. Weak battery at the receiving end or imperfect connections. Transmitter at sending end may be defective. Faulty receiver

Noises. Loose connections in line or battery circuit. Too much battery. Bent diaphram on receiver or particles of foreign substance on the magnets.

Rings O K but cannot hear at either station. Imperfect receiver cord or broken wire in the instrument circuit.

Bell rings without cause. Swinging cross with foreign wires or jarring of instrument.

In the early days of telephony it was considered that any kind of construction was good enough for telephone work, and as a consequence telephone installations were constantly out of order. Today the reverse is the case, the very best construction is none too good, and every possible requirement in construction and equipment is carried out to the smallest details. A very little consideration of the case is required to see how necessary this is. The telephone is one of the most sensitive electrical instruments known, and as it is so sensitive, the introduction of all foreign currents on the line, either by induction or leakage must be guarded against. The telephone current as transmitted is a feeble current, and therefore leakage or undue resistance must be avoided. Great care care should be taken to see that all contacts are bright, firm and clean. The automatic hook connections should make perfect contact and the hook spring should be powerful enough to bring the hook up to the proper position each time.

It is always safe to examine all connections when looking for trouble, especially those where wires are likely to become bent or twisted. The use of dry batteries is warranted by their cheapnesa, ease of handling and the general satisfaction they are giving in this branch of electrical work. There are a number of good makes which will give good satisfaction for six months to a year, according to use, and at the end of that time should be replaced with a new cell. Wet batteries of the salammoniac type are as efficient as dry cells, but should be kept where breakage or freezing can do no harm, and the cells should be frequently inspected to avoid drying up and crystalizations of zinc.

It will be found by experience that the best types of commercial receivers and transmitters seldom get out of order when carefully handled. The most prolific trouble is loose connections.

PATTERN MAKING FOR AMATEURS.

F. W. PUTNAM.

VIII. Base Piece of Small Jack Screw. — Handy Appliances.

The next pattern to be described is for the base piece of a small jack screw, the design of which was made by J. M. Tate of the University of Minnesota.

Fig. 47 shows a sectional view of the casting, and Fig. 48 the required pattern. It will be noticed that the top core print, *B*, is tapered, indicating that the pattern is solid and not a split pattern. Fig. 48 indicates this, the centre line being added simply to show the parting line if a split pattern is used.

If a solid pattern is made, only the core print, *B*, will be molded in the cope, all the rest of the pattern being in the nowel, the core setting vertically in the mold. A piece of stock $5\frac{1}{2}$ in. square and $5\frac{1}{2}$ in. long is necessary for constructing this pattern if the grain of the wood is to run parallel to the long axis. As a piece of stock of this size will be hard to obtain, the pattern may be made in the fololwing manner. Prepare two pieces $5\frac{1}{4}$ in. square and $2\frac{1}{8}$ in. thick, planed on both sides until true parallel surfaces are obtained. Glue these two pieces together and clamp carefully in a vise until the glue has become thoroughly hard. Mark a circle $5\frac{1}{8}$ in. diameter on one of the faces of this block and cut to as near this circle as possible with saw and chisel.

Place the block on the screw centre and turn to the required shape and size, using templets to aid in obtaining the desired curves. The core prints are shown in Fig. 49 and are to be turned and fastened to the pattern as in previous exercises.

The core box for the pattern is shown in Fig.

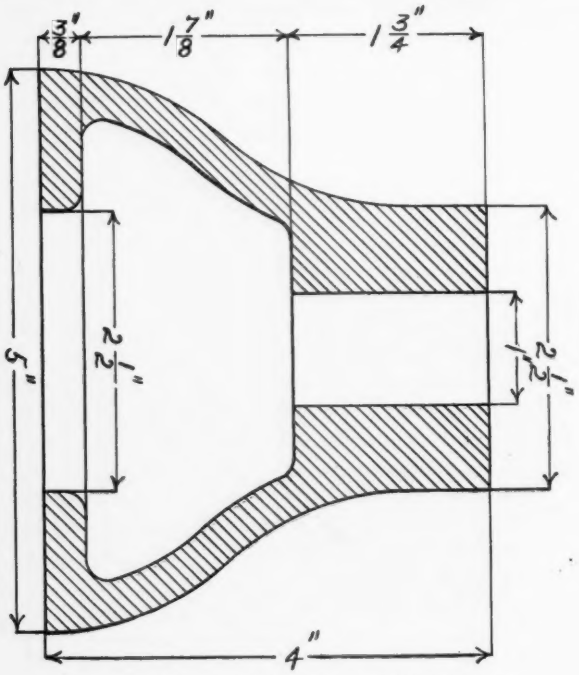


FIG. 47. CASTING FOR BASE OF SMALL JACK.

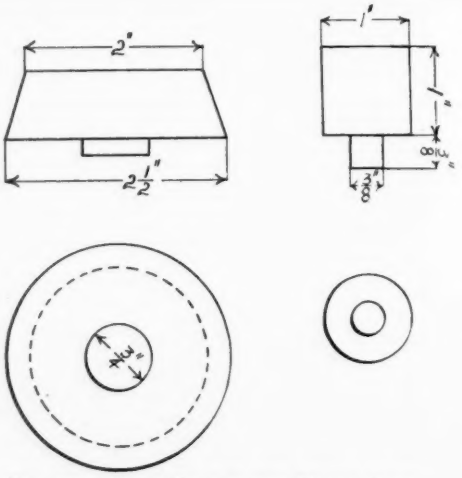


FIG. 49. CORE PRINTS FOR SMALL JACK.

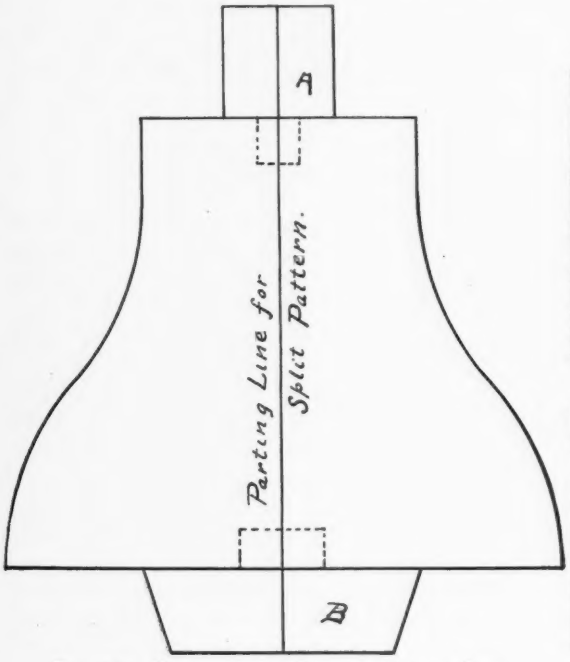


FIG. 48. PATTERN FOR BASE OF SMALL JACK.

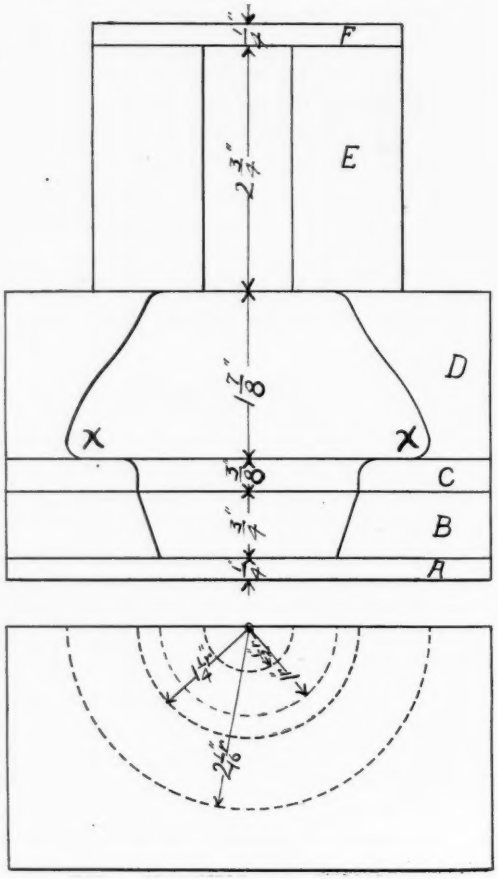


FIG. 50. CORE BOX FOR SMALL JACK.

50, a half core being used. It will be advisable to make this core box of six-pieces of stock, as indicated in the figure. *A* and *F* are simply end pieces of stock. *E* is to be laid out with compasses, square and gauge and pared out with the gouge. *D* should be attached to the face plate and turned out with a round-nose chisel, using a templet to test the curves. Use a block 5½ in. square and 2 in. thick for this work, and make sure that the screws which fasten it to the face plate do not interfere with the turning.

FIG. 52. PATTERN MAKER'S CAN.

bottom of the mold. If it is found on trial tha this does happen, a split pattern should be made, in which case the core print, *B*, Fig. 48 will be straight instead of tapering.

In this and in many of the following articles on pattern making will be shown cuts of various tools, appliances, etc., used by pattern makers and in the foundry. These cuts have been very kindly loaned me by the S. Obermayer Company of Cincinnati, Ohio.

Fig. 51 shows a Pinch Dog, referred to in my September article as being used for fastening two pieces of wood together for turning in a lathe.

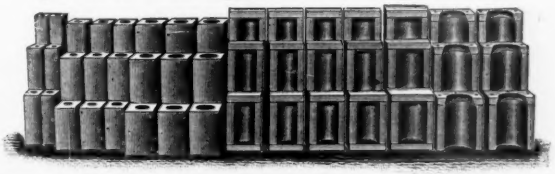


FIG. 54. SET OF CORE BOXES.

Fig. 52 shows the Economic Seamless Steel Can for shellac, paint, varnish, etc. The hermetical seal preserves brushes and contents. This can is made from smooth surface, cold rolled "Sweedish" steel, drawn seamless, in two parts. It commends itself at once to pattern and cabinet makers and all who use fine paints, varnish and shellac.

Fig. 53 shows labor saving leather pattern fillets. This style of fillet is a great time and labor

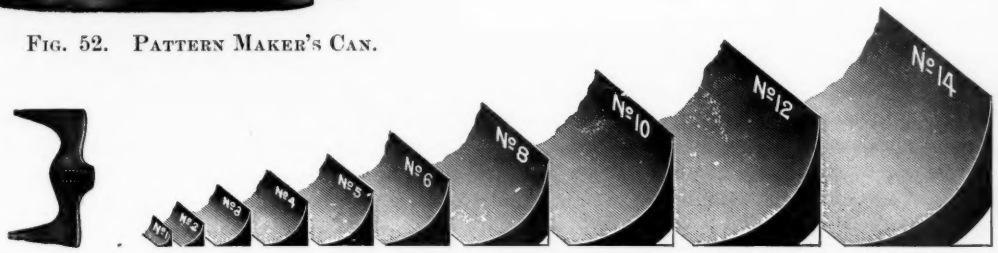


FIG 51. PINCH DOG.

FIG. 53. LEATHER PATTERN FILLEES.

When the block is finished, remove it from the face plate and cut it in halves, with the grain, using the smoother half for the core box.

There is one objection to the making of this pattern solid and using a vertical core, and that is the danger of the core breaking or crumbling away at *X*, Fig. 50 and dropping down into the

saver as the applying of it is accomplished with a single operation. It is not affected by heat, cold or moisture, any more than is the pattern.

Fig. 54 shows a set of standard core boxes consisting of fourteen sizes and three lengths to each size. They are made of hard poplar and are in very common use.

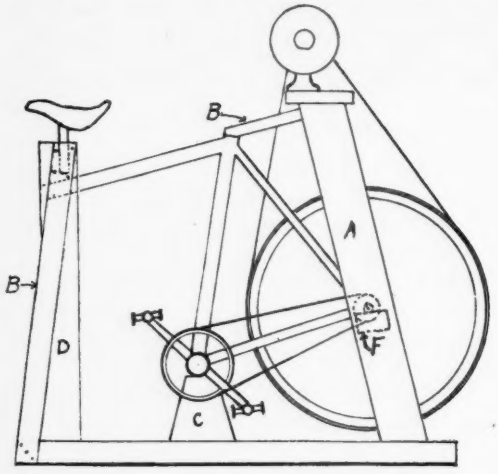
HANDY HINTS FOR AMATEURS.

Contributions are solicited for this department, and for each accepted article the sender will be given the choice of any one-subscription premium from our premium offers.

BICYCLE FOOT POWER.

W. C. HOUGHTON.

Most boys have, or can obtain at a very small expense, a bicycle that has passed its usefulness as such. If the frame, crank shaft, chain and rear wheel are in fair condition, it can be converted into a first-class foot-power for an emery wheel, a dynamo or any high speed machinery.



First remove the front fork, wheel, etc., and cut off the top bar of the diamond close to the steering head. Cut away the lower bar close to the crank-hanger. Remove the rear tire and fasten some strips of lead all around the groove in the wood rim. These can be cut from old lead pipe. Take care to distribute the weight evenly all around. Next plane out a long, thin strip of wood as wide as the rim and a little thicker in the middle than at the edges. Bend this around the rim and secure with small nails or screws. This is for the belt, which does not run properly in the groove.

Next build a frame, as per the drawing. No dimensions are given, as the size and proportion of the parts will vary according to the dimensions of the bicycle used. The drawing is, however, made to a scale of 1 in. = 1 ft. The base board should be about 4 ft. long and 2 in. thick and about 15 or 16 in. wide. The supports, *A*, should be 2 in. x 4 in and put far enough apart to let the rear axle between them. The axle is to be fastened to blocks *F*. The supporting block, *C*, and saddle post, *D*, are sufficiently explained by the drawing. The saddle post should be rigidly braced from the base by braces, *B*. Braces should also be put at *G*, between the top of the diamond and the main supports, *A*. The saddle should be rigidly fastened in the post. This may be done by drilling a hole through the wood and the steel tube and driving in a large wire nail. The crank hanger may be fastened to the block, *C*, with thin steel straps put over it and screwed to the wood.

Such a foot power as this this will easily drive an emery wheel 2000 or 2500 r. p. m. with moderate pedaling.

NAIL AND SCREW CABINET.

F. E. LINDSAY.

The cabinet herein illustrated is designed to do away with the needless boxes of nails and screws which too often litter up the shelves and work-bench of a small shop. Room is valuable, and it also requires time to hunt through such a mass.

This cabinet has three drawers, the upper one for brads and nails, the middle one for wood screws. It is designed to go either above or below the work bench in such a convenient position that it may be readily opened with one hand. If above the bench the case should be placed at such a height that the lower drawer can pass over tools lying on the bench without striking them.

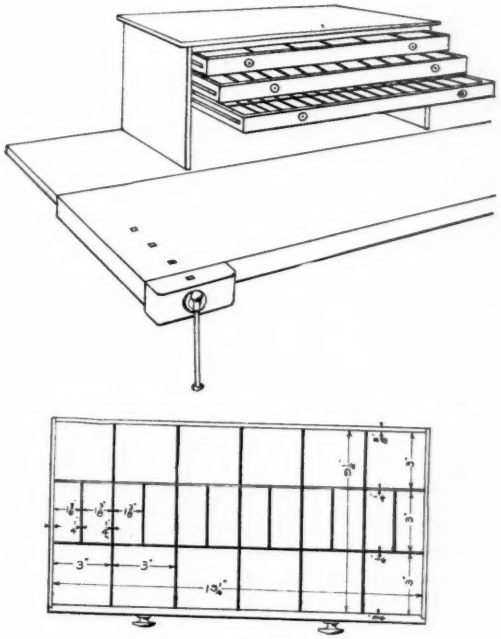
The drawers are made rather shallow, so that the smaller divisions may be readily reached. The boxes in the front row are each capable of holding a full pound of wire brads, while the middle row is provided with smaller boxes for odd sizes and tacks. The back row holds large nails, which are less used than the smaller sizes.

The middle drawer has much smaller divisions on account of the smaller number of screws generally in stock. The front row may be used for flat head iron and brass; the two adjoining boxes holding the same size screws and the middle row containing the same sizes in round head screws. The back row may be used for very large screws.

The under or bottom drawer is to contain machine screws of various sizes disposed to best advantage. The front row may contain iron screws in flat and round heads, and the middle row the corresponding size in brass. The boxes in the rear can hold the large sizes, nuts and washers.

In fitting the divisions glue them as well as nail, and see that they fit close to the bottom so that the smaller pices cannot slip underneath. Give the drawers two or three coats of shellac. The sides should be provided with $\frac{1}{2}$ in. grooves $\frac{1}{4}$ in. deep, which slide on a rail of corresponding size fastened to the side of the case. This form of slide is easily made and works very smoothly.

Anyone who has not possessed such a cabinet can hardly realize its great advantage. It is well worth the time spent on it, as will be granted by anyone making one.



NAIL AND SCREW CABINET.

NOTES ON WIRELESS TELEGRAPHY.

L. T. KNIGHT.

I. Nature of Wireless Telegraphy.

Wireless telegraphy is the name given to the transmission of dots and dashes by means of waves set in the ether by powerful oscillating discharges.

Ethral waves conveying perceptible light and heat have long been recognized, and these waves are known to have a velocity of propagation of about 180,000 miles per second, differing from one another only in their wave length and frequency. Violet light waves have a frequency of 750 trillions, and the lowest perceptible heat wave is estimated at 160 trillions per second.

With the discovery that an electric spark or discharge could produce disturbances at a distance without a conducting medium, came the general acceptance of what has been styled the Hertzian wave, a new and distinctive wave, possessing practically the same velocity as other etheral waves and likewise capable of reflection, deflection and refraction.

Early experiments consisted merely of devising apparatus for sending Hertzian waves into space and receiving the same at a distance. More recent experiments have been devoted to the adjustment of wave lengths, with the intention of perfecting methods whereby messages can be sent to predetermined points speedily and without fear of interference.

Since the velocity of all etheral waves is about the same it will be found that the length varies inversely with the frequency. In a recently published article on etheral waves, by a foreign scientist, was given such an admirable description of the relation of the aerial wire and the

wave length, that the writer prefers to quote a paragraph or two, instead of setting forth the same matter in a less masterly way.

"If a rod of steel be held firmly by one end and struck a sharp blow, it will vibrate at a *frequency* depending entirely on the *length* and other *physical* properties of the rod. The *period* of this vibration will be the same in all parts of the rod:—the *amplitude* will vary from nothing at the held end to a maximum at the free end. Similarly, if a wire or other conductor having one end insulated and thus free to vibrate electrically, while the other end is held at a constant potential by earthing or other means, be struck an *electric* blow, electric oscillations will be set up in the wire, the *freguency* of which will depend entirely on the length and other properties of the wire, and the *amplitude* of this vibration (alternating potential) will vary from nothing at the earth end to a maximum at the free end.

If the steel rod had been struck a number of light blows properly timed, the same *amplitude* of vibration could have been obtained as by the single heavy blow, but these light blows must be properly timed. From the oscillatary nature of the electric spark it is not practicable to strike one heavy blow and so get the vibratory or radiating effect. The frequency of the blows delivered by it must be suited to the natural frequency of the wire. This accord of spark frequency with aerial wire is known as *resonance.* When perfect resonance is obtained the aerial wire vibrates freely and sets up an electrical wave in the ether which can be shown to be proportional to the length of the wire."

But in a simple installation, where one terminal of the spark gap is connected to one end of the aerial wire and the other terminal of the spark gap connected with the earth, the capacity of the aerial wire being small and likewise the quantity of oscillating electricity small, the oscillations are short lived and not likely to be effective at any distance.

The value, therefore, of a closed circuit installation presents itself, and this subject will be fully treated, together with diagrams, in future articles.

CHEMICAL FIRE EXTINGUISHER.

WILLIAM K. SLYKE.

If there is any place where fire is likely to occur it is in the amateur's workshop, especially when he is experimenting with combustible chemicals, and if it should start from oil, naphtha, benzine, tar, varnish and similar inflammables, water has little or no effect. The Chemical Fire Extinguisher, however, makes short work of such fires. The stream from it is mainly water impregnated with a chemical gas. This gas is carried with the stream and has an effect on the fire independent of the actual stream itself. To make such an extinguisher is not a hard task, the hardest part being the tank, which should have a capacity of about three gallons, although smaller ones can be made. The one here described is of this size, made from about No. 10 gauge copper plate and must stand at least 150 pounds pressure to the square inch, the stronger the better. The seam of the tank should be riveted and soldered, as should also the top and bottom. Tanks of the required size can be made up at any plumber's supply shop.

In addition there is also needed a $2\frac{1}{4}$ in. brass coupling and a brass plug to fit the coupling. The coupling should be cut in half with a back saw, as it is too long; the other half can be used for another extingusher. In the centre of the top of the tank cut a hole large enough to admit the coupling snugly; have about $\frac{1}{2}$ in. of the coupling on the outside so as to solder it in the tank which will make a good strong job.

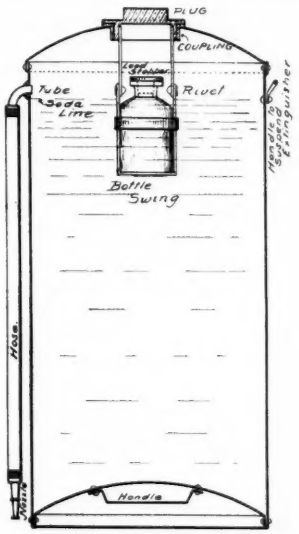
Next, get a bottle capable of holding four fluid ounces of sulphuric acid. This bottle should be narrow enough so that after it is in the holder it will slip easily into the tank through the opening in the coupling.

From the brass plug a holder must be suspended to hold the bottle. Cut a circle in brass $\frac{1}{16}$ in. thick, a trifle larger than the bottom of the bottle. No dimensions can be given, as the bottles will

no doubt differ somewhat in size and shape. Then cut two strips of brass ½ in. wide and ½ in. longer than the length of the bottle. This extra ½ in should be turned at right angles to allow the strips to be soldered to the round piece of brass. At the long end of these strips and about ¼ in. from the end, drill a ⅛ in. hole. Solder these strips to the round piece of brass. Half way from the top of these strips solder another strip of brass ½ in. wide, forming a circle of the same diameter as the bottom circle; this will keep the bottle from falling out. See Fig. 1. Make two more strips of brass ½ in. wide and about 2½ in. long, turn in ½ in. to allow a good soldering surface, as these ends are soldered to the under side of the plug. In the long ends of these two strips bore ⅛ in. holes. A copper rivet is now passed through the hole in each of these strips, as shown in Fig. These should not be riveted too hard, as they are to act as a hinge, allowing the plug to be turned back so that the bottle can be inserted easily. Next, make a lead stopper for the bottle; this should fit very loosely, so that if the bottle were tipped neck down the stopper would easily fall out.

On the side of the tank 1 in. from the top, drill a hole and insert a short piece of ½ in. brass tubing bent to form an elbow and soldered in place as in Fig. 1. Slip on a piece of 1 in. rubber hose about the length of the tank. This hose should be of good quality and strong enough to withstand the required pressure of about 80 or 90 pounds. An excellent way is to wind electric tape around the outside. To the free end of the hose attach a small nozzle with an ⅛ in. outlet. This hose should be fastened very securely to the tank and nozzle with several turns of copper or brass wire. The extinguisher is charged as follows: Fill the tank with water within four inches of the top, into the water dissolve 1½ lbs. of bi-carbonate of soda, which can be procured at at any drug store. Fill the bottle with 4 fluid ounces of sulphuric acid, leave the neck of the bottle empty, insert the lead stopper and place the bottle in the holder; then insert the bottle and holder in the coupling in the top of tank and screw down tight. A leather washer should be placed on the plug. The plugs should be of the shape shown in the drawing. To the sides of the tank should be soldered a handle for carrying and hanging up. There should also be a handle on the bottom of the tank.

To operate the extinguisher it is only necessary to carry to the fire and turn it upside down, using the bottom handle to hold it and direct the stream, which will be very powerful. It will be seen that when the tank is turned upside down the plug will fall out of the bottle, thereby allowing the



acid to flow into the soda solution. As soon as the two liquids meet carbonic acid gas is generated in quantity, forcing the water out of the nozzle with great force; the water is also impregnated with this gas, which acts as a blanket to the flame. When inserting the bottle in the tank see that the neck of the bottle will be above the soda line. The bottle holder should, if convenient, be tin plated on the inside. The extinguisher should be charged and discharged at least once a year cleaning all the parts before recharging. The extinguisher should hang in a central location easy of access at all times.

The London Daily *Mail* has the following. Medical men and nurses abounded at the recent opening of the Medical Exhibition. One stall contained nothing but samples of a new anæsthetic which bears the restful name of "somnoform", a liquid the boiling point of which is 23° below zero. The moment it comes in contact with air it becomes a gas. Its great virtue, from a medical point of view, is that breathing stops before the heart when it is administered.

AMATEUR WORK.

DRAPER PUBLISHING CO., Publishers,

88 Broad St., Room 522, Boston, Mass.

A Monthly Magazine of the Useful Arts and Sciences. Published on the first of each month for the benefit and instruction of the amateur worker.

Subscription rates for the United States, Canada, Mexico, Cuba, Porto Rico, $1.00 per year.

Single copies of back numbers, 10 cents each.

TO ADVERTISERS.

New advertisments, or changes, intended for a particular issue, must be received at this office on or before the 10th of the previous month.

Entered at the Post Office, Boston, as second class mail matter, Jan. 14, 1902.

OCTOBER, 1904.

Note the new address, 88 Broad St., Room 522,

With this issue we close the third year of publication of this magazine. During this time many incidents have occurred to encourage us and which show that our work is meeting with full appreciation from our readers. The value of the magazine in both a practical and educational way is amply evidenced by the many letters we are constantly receiving, and which serve as a stimulus to further and better efforts in this direction. Our staff of contributors is being constantly enlarged, so that we can in the future present subjects of continued interest and value to the amateur worker.

During the coming year we shall continue to present many topics relating to mechanics, electricity, wood working, boat building, photography, as well as articles having special bearing on these subjects. The making of machines and instruments likely to be of service to the amateur will receive a prominent place. Constructive work for the junior department will also be given due prominence. Altogether we feel that our readers will find much which will be directly helpful and of value. Suggestions are desired and welcomed and will be utilized so far as it is possible to do so.

One of the latest of our readers to receive the "Amateur Lathe" writes: "It is a very fine machine. I expected a great deal of the lathe, but it far exceeded my expectations." Another one writes: "I don't see how you can offer such a fine lathe at the liberal terms upon which I received mine."

A turning lathe is such a necessary tool to amateur mechanics that those without them should consider the purchase of one at the earliest which their means will permit. For small work the "Amateur Lathe" is just what is wanted.

Volume III., bound in cloth, uniform with the two previous volumes, will be ready about Oct. 20. Price $1.50, postpaid. The three volumes, bound in cloth, and a subscription for the fourth year, will be given for $4.50.

Consul Jackson, La Rochelle, France, reports: A part of this consular district, principally in the southern section, has been invaded by immense numbers of "campagnols" or field mice (*Arvicola agrestis*). The presence of this diminutive pest has caused serious concern in the agricultural districts, for the powers of destruction possessed by one of the creatures are tremendous. It not only destroys large quantities of living vegetation in seeking its food, but lays away an ample stock for winter consumption. There is scarcely a living plant within its reach that is not eaten or destroyed by it.

It has been calculated from experiments that each adult field mouse eats from two-thirds of an ounce to 1 ounce of living plants a day, which means a consumption of from 16 to 24 pounds a year. It is estimated that the average number of field mice to be found upon a hectare (2.47 acres) was 1,350. They consumed anually at least 13½ tons. It will be seen, then, that the anxiety among farmers is justified. The method used to destroy these pests which is considered most efficacious is by a microbe which is deadly to rats and mice only, domesticated animals being immune to its influence. This method of destruction has been recently commenced and carried out on a surface of 2,800 acres, and has proved to be able to accomplish the destruction of the mice, while the game, fowl and other animals of the farm were in no instance affected.

DESIGN FOR A LIGHT GASOLENE CAR.

J. C. BROCKSMITH. M. E.

Reprinted by Special Arrangement with the American Electrician.

The crank shaft is shown in Fig. 9. This is preferably made from a solid open-hearth steel forging, the cranks being cut from the solid metal. Figs. 10 and 11 show respectively the top and bottom halves of the crank case. These are intended to be cast in aluminum alloy containing about 25 per cent zinc. The halves should be planed and carefully surfaced where they bolt together; this joint should be perfectly gas tight, and it is preferable not to use packing but to rely on the surfacing and the bolts for drawing the parts in close contact.

Fig. 12 is a detail of the contact maker for use with jump spark ignition. A spark is required in each cylinder once in each revolution, and since the cranks are at 180° the contacts are also arranged 180° apart. The plate upon which the contacts are mounted is bored for and centered upon the main bearing boss. The plate may be made of aluminum or brass and only the stationary contact need be insulated from it. That is to say, the spring blades are grounded on the engine frame, which is a necessary part of the scheme of connections.

Fig 13 is a diagram of connections of the sparking apparatus. A separate coil is required for each cylinder. For spark coils and plugs the builder will do well to purchase standard articles. Also in regard to the carburettor, it is probable that more satisfactory results will be obtained from a ready-made article than from one of the home-made variety.

Fig. 14 shows the details of the motor fly-wheel and clutch. The wheel is of cast iron and is to be turned all over, the inner surface of the rim to be finished to a 15° taper and forms the female portion of the cone clutch. The male portion of the clutch is a disc of aluminum alloy faced with leather and riveted to a steel centre which is bored to fit the reduced end of the crank shaft. A spiral spring forces this disc into contact with the fly-wheel surface, so that the cones are always in engagement except when the clutch pedal is depressed while changing from one gear combination to another. The spring pressure thus applied is entirely self contained and does not produce any end thrust upon the motor or change gear bearings, due to the fact that the fly-wheel is covered by a cap which takes care of this thrust and at the same time forms a dust proof cover for the parts. In order to disengage the clutch the shaft carrying the male cone must have an endwise motion of about $\frac{1}{4}$ in., which is allowed for in the jaw clutch that connects the motor shaft to the speed change gear.

Fig. 15 shows the speed change gear, with the top half of the case removed to make clear the arrangement of the gears and their operation. The driving shaft is round and has secured to it by means of pins four gears of different diameters. The driven shaft is square and has mounted upon it a spider carrying three gears of suitable diameters to mesh with the gears on the driving shaft. The spider may be slid endwise along its shaft so that any desired pairs of gears may be engaged. The drawing shows the gears engaged for the first forward speed, which gives the highest ratio of engine turns to rear wheel revolutions. The reverse speed gives the same ratio as the first forward speed except that an idler gear is interposed between the driving and driven shaft, thus changing the direction of rotation. The reverse gear is obtained by moving the gears to the left of their position in the drawing, and the two other forward speeds are obtained by moving the spider to the right of its present position. The centre lines at the extreme right of the figure indicate the exact distances through which the shifter rod must be moved to get the various combinations. The universal joint which transmits the motion to the rear axle gear and also in the brake drum are shown in this view. The accompanying table gives the data for gear ratios and sizes of gears for various combinations:

Fig. 16 is a top view of the complete gear and case, showing the length of arms for bolting to the frame work of the car, the shifter rod, brake drum, removable cover and universal joint. Fig. 17 is an end view of the gear case, which helps to make clear the position of the idler gear by means of which the reverse speed is obtained. It also shows the screw plug at the bottom of the case, through which the old oil may be drained off. The case should always be partly filled with a heavy oil and the gears and bearings are then lubricated automatically. The best practice indicates that all gears should be cut from machine steel, have the teeth rounded or beveled on the edges, and then case hardened. If for any reason this is impracl ticable, phosphor-bronze might be used, though it wil not, of course, wear as well. Cast iron is, of course, out of the question, as it is so brittle that the teeth would be likely to strip in changing speeds.

Fig. 18 shows the construction of the rear axle and the bevel gear drive. The revolving portions of the axle are of $1\frac{3}{8}$ in. solid steel turned down to 1 inch at the hubs and keyed in. The differential gear is of

CONCLUDED FROM SEPTEMBER.

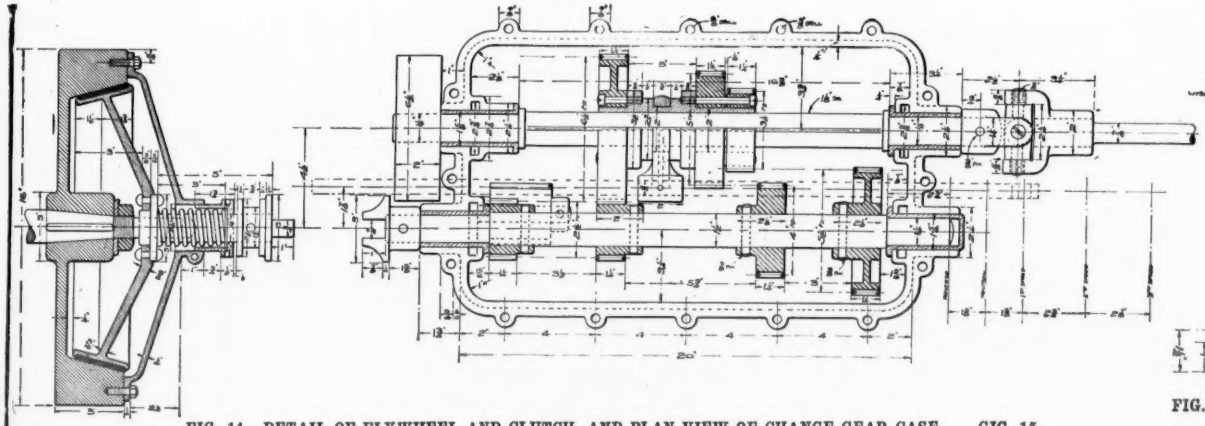


FIG. 14. DETAIL OF FLYWHEEL AND CLUTCH, AND PLAN VIEW OF CHANGE GEAR CASE.. GIG. 15.

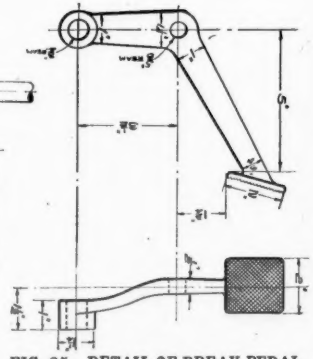


FIG. 25. DETAIL OF BREAK PEDAL.

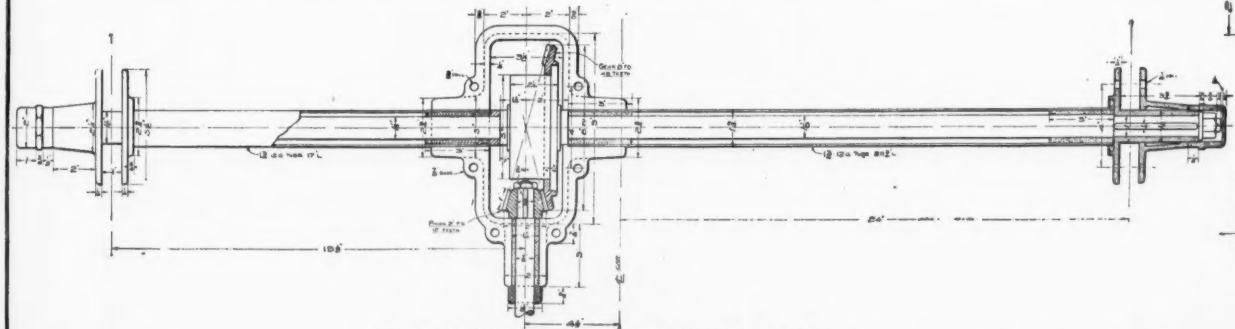


FIG. 18. DETAILS OF REAR AXLE AND BEVEL GEAR.

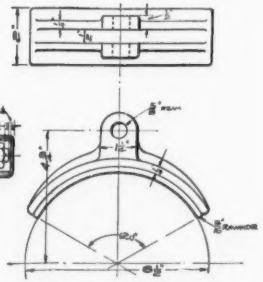


FIG. 26. DETAIL OF BREAK SHOE.

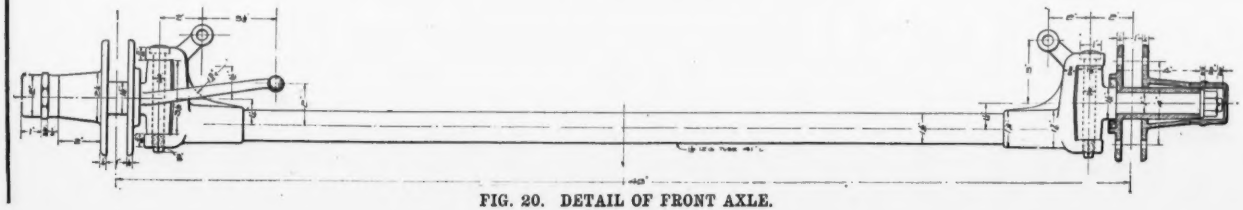


FIG. 20. DETAIL OF FRONT AXLE.

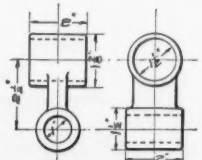


FIG. 21. DETAIL OF FRONT AXLE REACH FITTING.

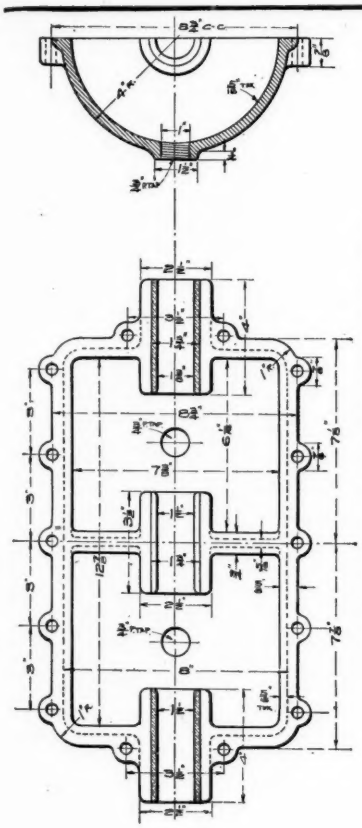


FIG. 11. DETAIL OF LOWER HALF OF CRANK CASE.

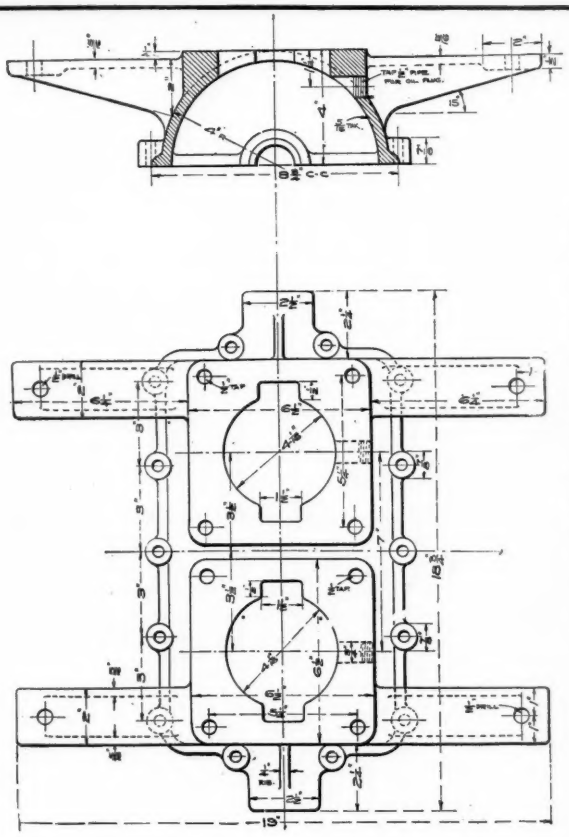


FIG. 10. DETAIL OF UPPER HALF OF CRANK CASE.

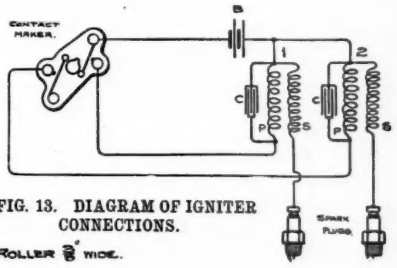


FIG. 13. DIAGRAM OF IGNITER CONNECTIONS.

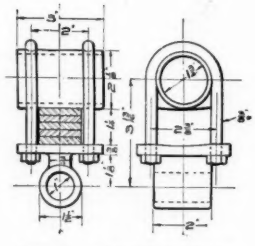


FIG. 19. DETAIL OF REAR AXLE SPRING CLIP AND REACH FITTING.

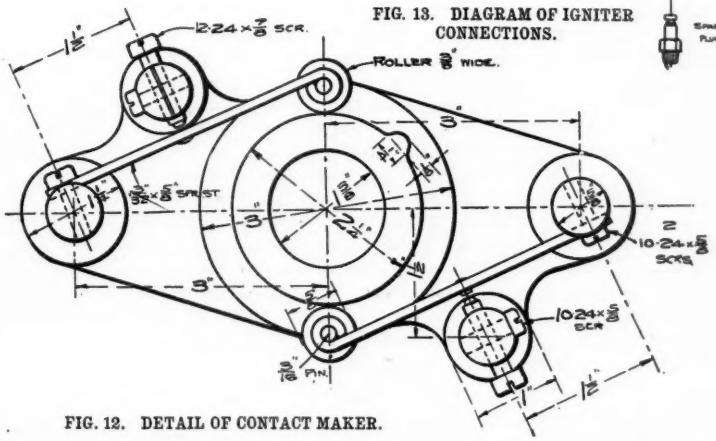


FIG. 12. DETAIL OF CONTACT MAKER.

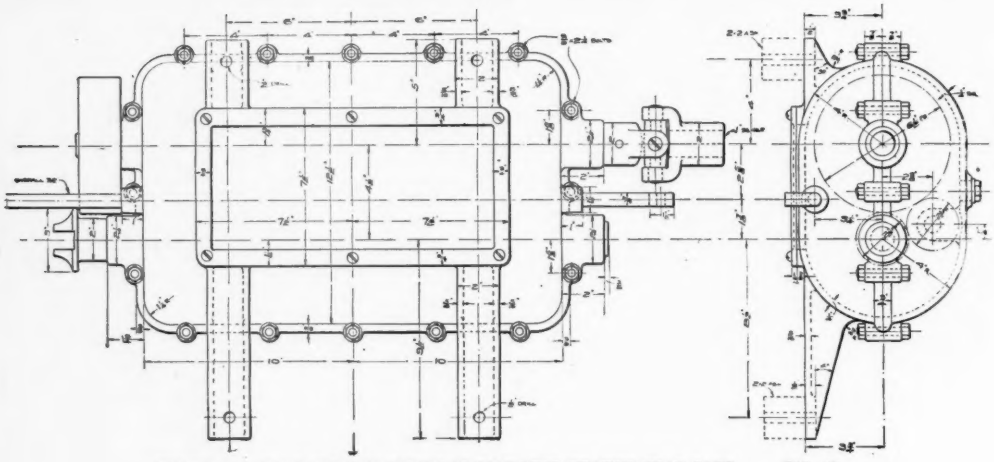


FIG. 16. PLAN AND END VIEWS OF COMPLETE CHANGE GEAR CASE. FIG. 17.

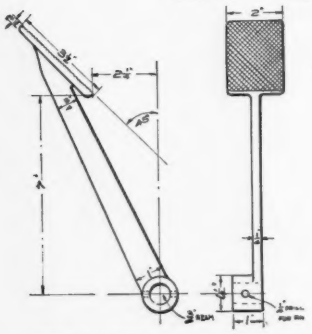


FIG. 23. DETAIL OF CLUTCH RELEASE PEDAL.

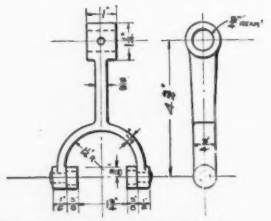


FIG. 24. DLTAIL OF CLUTCH FORKED LEVER.

standard construction and is, therefore, not detailed. The hubs may conveniently be of phosphor-bronze or steel. The gear case is intended to be cast of aluminum alloy containing 25 per cent zinc. The same is used for the engine crank case and the change gear case. The revolving portions of the axle are enclosed in a $1\frac{1}{4}$ in. steel tube which is fitted with phosphor bronze bushings at its extremities. It will benoted in this connection that only plain bearings are used all through the construction of the car. Fig. 19 is a detail of the spring clip fitting for the rear axle. This consists of a steel casting which is bored to fit the axle tube and is clamped thereto and to the spring by means of a pair of $\frac{3}{8}$ in. "U" bolts.

Fig. 20 shows the construction of the front axle and hubs. The axle consists of a length of $1\frac{1}{4}$ in. tube brazed into the forked steering ends. The front hubs are the same as the rear ones with the exception, of course, that they are bored a running fit for the axle instead of being keyed on. Further details of the axle ends can be obtained from Fig. 2. Fig. 21 shows the reach fitting for the front axle. This is bored to fit the front axle tube and the reach is intended to be a turning fit for the lower portion so that the running gear may adjust itself to any unevenness of the road. The reaches consist of a pair of steel tubes, the location and length of which may be seen in Fig. 1. They have solid ends brazed in and a nut placed on the outside.

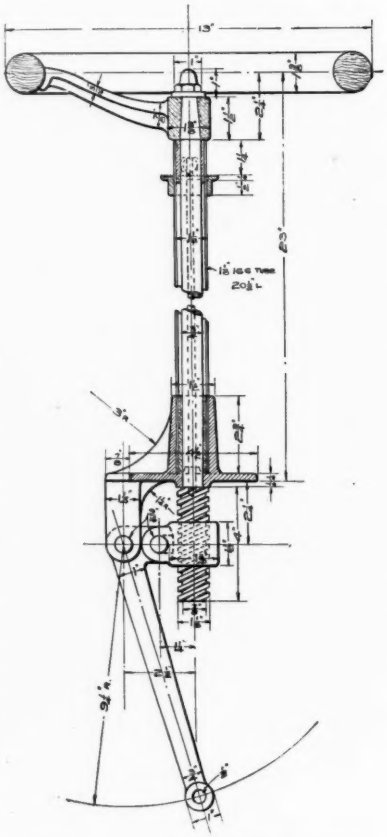


FIG. 22. DETAIL OF STEERING COLUMN.

Fig. 22 shows the construction of the steering column. The tubular portion is stationary and has attached to it near the top the spark and throttle levers; the centre rod turns with the hand wheel and operates the screw at the bottom. The screw is 1⅛ in. outside diameter and has three threads with a pitch of one thread per inch. The proportions of the linkage are such that about one and one-half revolutions of the hand wheel are required to turn the front wheels from one extreme to the other.

Figs 22 and 24 show respectively clutch, release pedal and the forked lever for disengaging the clutch. The latter has a pair of small rollers on the forked ends, which engage the grooved collar on the clutch shaft for drawing the cones apart. Fig. 28 shows the brake pedal. This, as well as the clutch pedal, should preferably be a steel forging. Fig. 20 shows the brake shoe, which may be a casting of alzinc and is faced with leather for friction surface. This may be secured to the metal surface of the shoe by means of shellac and a considerable number of wooden shoe pegs. The wear on this facing will probably be rapid but it can be easily and cheaply renewed.

TOOL MAKING FOR AMATEURS.

ROBERT GIBSON GRISWOLD.

III. Special Tool Steels.

In this chapter we touch for the first time the domain of special tool steels. The small hand tools treated in the first two chapters were all made of what is commonly known as ordinary tool steel, which is technically termed a "high carbon steel" and can be hardened in water or oil.

Lathe tools, however, are usually made of a special self-hardening steel that will not bear water, but must be hardened in a current of air. The reason for this is that they are in general harder than a carbon steel and hold their edges better; in fact, some of them will hold their edge while red hot under the chip. It is this quality which makes the new high-speed steels so valuable. With them the cutting speeds are materially increased, which lessens the cost of production.

These steels are made by what is known as the *Crucible* method. For those unfamiliar with the process a short description will be given. It may be well to add that the structural steels are made by what is known as either the *Open Hearth* or the *Bessemer* process. In the former the steel is melted in a large furnace and poured from there into large ingot moulds. In the Bessemer method the steel, after melting in a furnace, is poured into a huge barrel-shaped receptacle through which a current of air is forced. In this receptacle, called the converter, the chemical changes take place, after which the molten metal is poured into molds as above. These are the two methods mostly in use today for producing steel in large quantities. The product might generally be termed a mild steel.

But the crucible steels are much more costly, owing to the greater cost of production. In the crucible process the materials used to make the steel are either bar iron, puddled iron or blister steel. The crucibles in which the steel is melted are made of clay or graphite, holding anywhere from 50 to 100 lbs. These crucibles are charged cold. The pieces of iron are placed in the crucible and thoroughly packed with charcoal, mixed with a little manganese, and occasionally a little ferryocyanide of potassium or common salt is mixed with it. The crucible is then covered and placed on the coals in a hot furnace.

After a period of three hours the cover is lifted, the charge having melted by that time and the melter determines upon examining the condition of the charge, the duration of the "killing" period, generally about 45 minues. During this period the metal is becoming tranquil and is absorbing silicon from the walls of the crucible, the latter element preventing blow holes. At the proper time, determined by the experience of the melter, the crucible is removed from the furnace and the molten charge skimmed of its slag, after which the metal is cast or "teemed" by pouring into split ingot molds.

These ingots are graded and converted into bars of various sizes. Owing to the fact that pure materials are used in making up the charge, and that it is protected from the sulphurous gases from the fuel, this crucible steel furnishes the finest grades for cutlery and machine tools. The Bessemer and open hearth steels are very much inferior to crucible steel, the latter having a low percentage of phosphorous, low sulphur, no iron oxide, less gases, high silicon and high carbon.

The crucible steels are graded about as follows, the grades becoming better towards the bottom of the list:

Die. Contains about .75 percent carbon, has little temper, is difficult to burn and welds easily.

Set. Contains about .875 per cent carbon, has little temper, easily welded and burns with difficulty.

Chisel. Contains about 1.00 percent carbon, has a fair temper and is not readily burned.

Spindle. Contains about 1.125 per cent. carbon, welds with difficuity, has hard temper and not very readily burned.

Saw-file. Contains about 1.375 per cent carbon, hard

temper and welds with some difficulty.

Razor. Contains about 1.5 per cent carbon, is very easily burned, has very hard temper and welds with extreme difficulty.

The effect of different elements on steel will be of interest at this place:

Carbon. Up to 1.5 per cent. increases tensile strength and raises the elastic limit; the welding power and malleability are decreased.

Silicon. Increased hardness, tensile strength and compression strength, homogenity and prevents blowholes, but too much makes steel brittle. From 3 to 5 per cent should be about the range.

Sulphur causes hot shortness, that is, the metal is brittle when hot, both under the hammer and rolls.

Arsenic. Same effect as sulphur.

Phosphorous. Causes cold shorteness. It makes steel hard and liable to break, but increases the elastic limit and reduces elongation.

Manganese. Prevents hot shortness and blow holes, removes or offsets the effect of sulphur; elongation, toughness and tensile strength are increased by its presence, but too much renders the steel brittle when cold, especially after quenching.

Copper. Causes red shortness.

Tin. Renders steel not forgable or ductile either while hot or cold.

Tungsten. Renders steel very hard.

While tempering was spoken of in the first article, it will be well to speak of the process of hardening and tempering more fully at this place. The combined processes of hardening and tempering steel give to it the necessary hardness combined with the requisite toughness. It takes more than mere hardness of cutting edge to make a good tool. A tool may be so hard that it will readily scratch glass and yet be totally unfit for turning even soft metals like lead and copper. This is due to fact that the process of hardening renders the steel very brittle, while the subsequent process of tempering reduces, or grades, the degree ot hardness and at the same time imparts to the steel a certain degree of toughness, which property enables the tool to hold the hardened edge without cracking off readily.

The tool, *after forging to shape*, is hardened by heating to a cherry red and plunging it into a bath of water, brine or oil, for a short distance above the cutting edge. The tool should be moved about in the cooling medium to prevent the clinging of steam or vapor bubbles, which would cause soft spots. The portion of the tool above the surface of the bath will remain at a dull red heat for some little time.

The hardened end is now quickly polished on a smooth surface by rubbing it with a strip of emery cloth glued to a flat stick. The heat in the stock of of the tool will now begin to creep into the quenched hardened portion by conduction and increase its temperature. As this temperature increases, the oxides will begin to cover the polished surface in distinct bands or waves, advancing in a regular procession as given in the table of tempering colors in first chapter, pale yellow, straw yellow, brown yellow, light purple to a dark purple, and finally a blue. As the desired color reaches the cutting edge, the tool is suddenly plunged beneath the water or oil and constantly kept in motion. This fixes in the steel the definite degree of hardness determined by the color, and the process has rendered the steel tough enough to stand up to its work. The entire process requires practice and thoughtfulness more than anything else to render one proficient There are many tools that will not stand such treatment. The above, of course, applies only to *carbon steels.* The self hardening steels should *never touch water* while hot. They are peculiarly air hardening steels.

One of the oldest and best carbon steels is the Jessop's steel. It hardens at a low red heat. In forging do so at a full red heat, but be very careful not to overheat, and avoid a strong blast. Heat uniformly, allowing time for the heat to reach the centre, and turn the tool in the fire so that one side will not be heated more than another. The fire should be of good size and free from sulphur. Do not try to forge steel at a dull heat. This should be used only at the finish. Stubb's steel is probably well known in the form of drill rods. Its treatment is the same as that for carbon steels.

Under the head of self-hardening steels come the Mushet, Jessop's Self-Hardening, Novo, Sanderson's, H. S. H. and C. L. makes. The Taylor-White process and Special steels require special treatment, the method being secret and sold only on shop rights.

In the case of the self-hardening steels, they are forged at a full red heat. To harden they are generally heated to a bright heat and set in a cool, dry place. They are *never* subjected to the action of water. The Jessop's self-hardenihg steel is heated to a white heat for hardening, as it cannot be burned. As a matter of fact, each special steel is generally accompanied by a label or card, giving directions for working and treating.

In the case of special formed cutter, large dies and taps and large hollow mills, the heating for tempering is generally done in hollow rings or between hot plates or some such method, to insure even, regular heat.

Large tools should be ground on a wet wheel to prevent the heat drawing the temper. Especially is this true with lathe tools. Use as fine a wheel as possible for finishing the edge, which should be smooth and keen.

In the newly invented apparatus for milking cows by electricity rubber hoods are attached to the udder of the cow. These hoods are connected with a vessel for receiving the milk by means of a rubber tube from which the air is exhausted by means of the electrical device. It is claimed that the cow "lets down" her milk more freely than when milked by hand. It is also claimed that absolute cleanliness of the milk may be secured when this method of milking is employed.

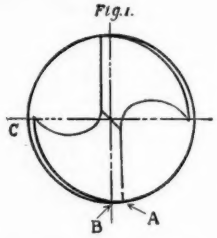
TWIST DRILLS; THEIR USES AND ABUSES.

By Courtesey of the Cleveland Twist Drill Company.

The advent of the now common twist drill marked a very important period in mechanical industry. It is, all things considered, the most efficient tool used by mechanics, as in no other tool is the cutting surface so large in proportion to the cross sectional area of the body or part which is its real support.

By actual measurement of the cross section of the fluted part only 50 per cent is left for effective work, yet it will bear more stress in proportion to its own strength than any tool, for the reason that it is supported by the metal upon which it is operating, and is thus prevented from springing away from its duty. This support may be of two kinds; first that due to the wedge-like action of the point, and the second that derived from the small amount of concentricity which the drill has just behind the cutting edges, see Fig. 1.

Fig.1.



The latter, however, is of little importance, as in a large number of cases only one side of the drill gives any support to the cutting edges, as will be seen in paragraph under grinding of points.

The support given the drill in the instance first cited is of more importance and arises from the tendeney of either cutting edge to spring away from the cut, which in a correctly ground drill is, of course, counterbalanced by the opposite cutting edge having the same tendency, only in an opposite direction, so that with the feed pressure on the drill tending to force the cone shaped point into a cone shaped hole, the drill is held rigidly in a central position.

A twist drill is a tool generally formed by milling or forging two equal and opposite spiral grooves upon a cylindrical piece of tool steel of such shape as to make a suitable cutting edge on its cone shaped end.

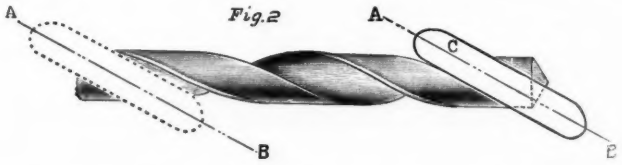
Drills are not of the same diameter from end to end of the twist, but decrease in diameter from the point towards the shank by an amount varying from .00025 to .0015 per inch in length, according to the size or particular use for which they are intended. This gives a longitudinal relief to the drill which is very essential in accurate drilling.

Neither are they exactly round, as their diameter is eased away from a short distance behind the cutting edge back to the flute, as in Fig. 1. The distance between *A* and *B* is of full diameter and round, while from *B* to *C* it is eccentric or, more strictly, is a surface whose cross section is a spiral with its centre in the centre of the drill. This is called *body clearance*. The object of this is to give radial clearance to the drill and thereby reduce the friction between the drill and the walls of the hole. Without this body clearance more power would be required to turn it and in some cases enough heat would be generated to draw the temper in the drill to a degree which would unfit it for further use.

To give the drills as much strength as possible the flutes decrease in depth toward the shank, that is the "web" between them gradually increases in thickness toward the shank; this is accomplished by gradually withdrawing the milling cutters as they approach the shank, and is called web increase.

This operation alone would seriously impair the

Fig.2



chip room in the tool, and to avoid this defect the spiral is increased in pitch by an amount that, combined with the web increase, will preserve the correct and equal cross sectional area of the flute from point to shank.

This is made plain by reference to Fig. 2 in which the cutter *C* is in position at the point of the drill with its path on line *AB*. As the blank is fed uniformly forward it revolves at a rate which is constantly diminishing, and as the axis of the cutter remains in a fixed angular relation to the axis of the drill, it is obvious that the flute will be wider at the shank end than at the point, and at the completion of the groove the cutter will be in position shown by dotted lines; but as the cutter is gradually withdrawn in depth the combination of these two movements retains the proper volume of the flute for free egress of chips.

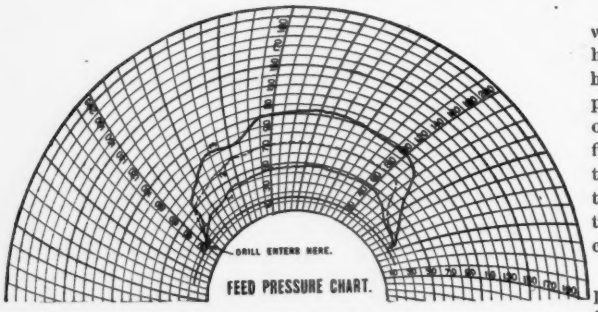
With a special apparatus for making an autographic record or diagram of both the feed pressure and the torsional stress when forcing a drill through a piece of metal, we performed experiments which showed the most efficient form of point, manner of grinding, etc.

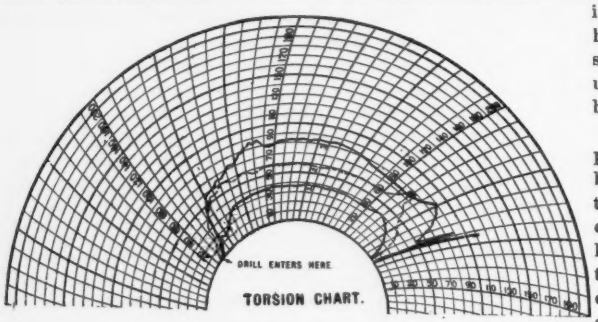
We replaced the usual swing table of a drill press by a special hydraulic one arranged so that the exact feed pressure and torsional stress was measured and recorded by two Bristel Pressure Gages, the clock

mechanisms of which were removed and a spring drum substituted by which the vertical movements of the drill spindle revolved the charts.

The charts shown are from a 1¼ in. drill, running 66 revolutions a minute with a feed of .0075 in cast iron, machinery steel and annealed tool steel. The concentric circle on feed pressure chart between lines reading 10 and 20 represents the weight of table and "billet" drilled into. The lines marked 1 are cast iron and show quite a uniform curve, while the lines marked 2 and 3 are respectively machinery steel and tool steel, and show more irregularity in the curves.

Fig.3. Fig.4 Fig.5.





The general contours of the feed pressure curves for tool steel are very much alike, showing a steady rise until the lips are cutting nearly full size, then dropping slightly, due to the spiral helping to pull the drill in, then rising again steadily to a point about a third through the billet, due no doubt to the billet not being annealed uniformly clear through.

The feed pressure diagrams fall off very rapidly as the point begins to come through, while the tension diagrams for steel rise very abruptly; and the tool steel one (the piece not being clamped down) shows plainly where the lips caught and raised the piece, giving several very quick jerks, a result which is experienced very often when holding a piece by hand to drill it.

These points indicate where the outer parts of the lips are generally broken, especially where lever feeds are used, or the spring berween the parts taking thrust is considerable. This feature is very common in the drilling of the rivet holes in cylindrical shells where the inside curvature greatly augments the tendency of the drill to "hog in."

The feed in this test was purposely kept down to

FIG. 6.

FIG. 7.

what may be termed fair practice in order to have the same grinding answer for all three holes. The difference between the curved lines pointing toward the centre represents a distance of .05 inch in depth drilled on both charts. To find the actual feed pressure in pounds multiply the indicated pressure on chart by 20. To find the torsional stress in pounds at the periphery of the drill, multiply the indicated pressure on the chart by 20 and divide by the diameter of the drill.

We found the shape of groove, the angle of point, the angle of spiral and the manner of grinding all affected the power needed to drill a given hole. The thickness of web also affected the result, but this is probably the most uniform feature on the different makes of drills, and varies but slightly.

A groove formed like Fig. 2 required the most power, while those like Figs. 4 and 5 gave the best results. A little study of Fig. 3 will show that the cutting edges are very poorly formed, especially toward the cutter where there is very little of the shape which will allow free curl to the chips. Fig. 4 represents a very free cutting drill; the shape of the groove is such that the chip curls up to the full size of the groove and very little power is consumed in feeding it. The form of the chip is very similar to an open string wound with ribbon steel, and somewhat resembles a cylinder in appearance, see Fig. 6. Fig 5 represents a form of point very desirable for several reasons and is the shape which we have adopted. It does not require any morepower (in fact slightlo less) than the point like Fig 4, and rolls a beautiful chip (see Fig. 7) of which each turn is slightly conical in shape, slightly less in diameter than that of Fig. 6, but they lie one within another so that the length of clip in drilling a

hole one inch deep is not a quarter as long as that made by a point like Fig. 4 drilling the same depth.

Our tests with different angles of points showed that the feed pressure varied almost directly with the number of degrees in the included angle of the point between 110° and 136°. Different materials gave somewhat different results, the variation being not so great in the harder materials.

JUNIOR DEPARTMENT

For the Instruction and Information of Younger Readers.

ELEMENTARY MECHANICS.

J. A. COOLIDGE.

IX. Specific Gravity.

We saw in our last chapter that every solid substance, when floating or immersed in a liquid. lost part or all of its weight, and that in bodies capable of floating, the shapes could be made such that additional weights could be carried. In this paper it is our purpose to study the buoyant effect of liquids on bodies that will sink, and to see whether this knowledge will

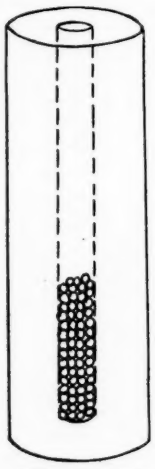


FIG. 26.

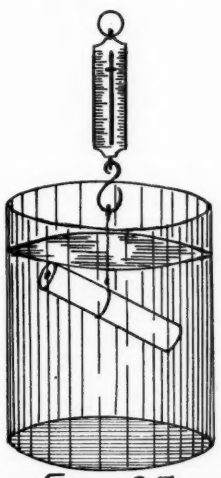


FIG. 27.

be of any practical value. In beginning we wish to find the exact relation between the buoyancy of the liquid and the substance immersed in it.

EXPERIMENT XXIII.

A cylindrical piece of curtain pole, 4 in. long and 2 in. in diameter, with a hole ¼ in. diameter bored in the centre of one end to within ½ inch of the other, will serve our purpose. Put enough lead shot or scraps of lead in this hole to make the cylinder sink in water, fit a wooden plug in the open end and soak the whole cylinder in melted paraffine so that it shall not absorb water. Weigh it carefully, and with a pair of calipers get its diameter as accurately as possible. The volume of the cylinder, radius x radius x 3 1-7 x length we must next find. It should be needless to say that the radius is one-half of the diameter and that the volume is equal to the base, radius x radius x 3 1-7, multiplied by the length. Next hang the cylinder by a thread and weigh it immersed in a jar of water. See Fig. 27. The buoyancy of the water is found by subtracting the weight in water from the weight in air. The weight of an equal volume of water is found by multiplying the volume expressed in cubic inches by .58. This will give the number of ounces of water displaced by the cylinder. When we compare this with the loss of weight just found we see that they are the same, and if the experiment should be performed with some other liquid than water, the same principle will be found true; that is, that the amount of loss of a body in any liquid is equal to the weight of the displaced liquid. The discovery of this made Archimedes famous in history and the word, eureka, well known to all. The story of King Hiero and the crown that he feared was not true gold, and how Archimedes proved that the king had been deceived, is a tale of interest to old and young.

EXPERIMENT XXIV.

Having studied this principle we are now prepared to examine a number of different substances and to compare them. Get a piece of coal, of glass, marble, lead, iron, zinc and, if possible, aluminum; weigh these in air and then in water, hanging them by a thread, as you did the cylinder in Fig. 27. The loss of each in water is equal to the weight of the displaced water. Is it not a simple matter to compare each with the weight of the same volume of water and then with another substance? For instance, our marble weighs 8.1 ounces in air and 5.1 ounces in water. The loss is 3 ounces, therefore three ounces is the weight of a body of water equal in volume to the marble. The ratio of the marble, 8.1, to the water, 3, gives us 2.7. We know that marble is 2.7 times as heavy as water. This ratio of a substance to the equal volume of water is called the specific gravity of that substance. Let us find the specific gravity of coal, glass, lead, iron, zinc, aluminum and others. and arrange as in the table below:

Substance	Wt. in air.	Wt. in water.	Loss.	Sp. Gr.
Marble	8.1	5.1	3	2.7
Coal				
Lead				

Of all the substances we have seen, gold is the heaviest, having a specific gravity of over 19. Lead is heavier than iron, and aluminum is the lightest of all the metals. Many metals are seldom used in a pure state but are mixed with some other metal (or alloy) to make them harder, stronger, more brittle or more elastic. Gold coins are not of pure gold but are mixed with copper to make them harder. The statement that gold is 18 k, means that 18 parts are gold and 6 parts copper. It can be seen that one might tell the purity of a metal if one knew its specific gravity.

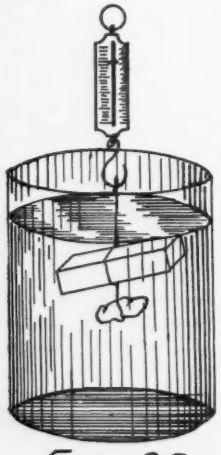


FIG. 28.

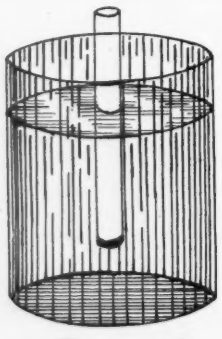


FIG. 29.

The finding of the specific gravity of woods and other bodies that float gives a little more trouble, as the shapes are often irregular, and as the body floats we must adopt some other means of finding the weight of the displaced liquid.

EXPERIMENT XXV.

Given an irregular piece of wood; find the specific gravity. Weigh it first and call its weight *W*. Take a piece of stone and weigh that in air, calling the result *S*, and in water, calling the result *S′*. Find the loss of the sinker. *S*—*S′*. Tie the stone to the piece of wood and weigh both in water, as seen in Fig. 28. From the sum of their weights in air take the weight of both tied together in water, and we have the loss of both. From this subtract the loss of the sinker, *S*—*S′*, and we have the loss of the wood. The weight of the wood divided by this loss will be the specific gravity of wood. This varies much for different woods, being as low as .11 for porous cork, up to .8 and .9 for heavy oak woods and others.

We must now find the specific gravity of liquids. Of the tests made for milk, vinegar, etc., the specific gravity forms a part. There are several ways of finding this, but we shall speak of two only. A small bottle with a tightly fitting glass stopple with the exact amount of water it contains marked upon it, and with a brass weight that just balances the empty bottle can be bought. This is filled with a liquid and the weight of the liquid alone obtained at once. This weight divided by the figure on the bottle will give the specific gravity of the liquid.

EXPERIMENT XXVI.

Take a small bottle with a tightly fitting glass stopple and find its weight, *B*. Fill with water and weigh again, calling this *T*. *T*—*B* gives the weight of the water. Fill the bottle with another liquid and call this *L*. *L*—*B* is the weight of the liquid in the bottle. Divide *L* by *T*—*B* and the quotient will be the specific gravity of that liquid.

EXPERIMENT XXVII.

Take a cylindrical wooden rod ¼ in. in diameter, flatten a lead bullet, or make a thick washer of lead and fasten to one end so that when placed in water it will float erect, as in Fig. 29. *A* very small elastic band, or thread, around it may be made to serve as a marker. It should be covered with wax to prevent soaking in water. Place it in water, mark the depth it sinks, and call this *Dw*. Do the same in some other liquid, such as vinegar, oil, or a solution of blue vitriol. Call this depth *Dl*. As a floating body displaces its own weight, the depths *Dw* and *Dl* give amounts of water and the liquid that have the same weight. Suppose those figures were 7.2 in. in water, and 5.4 in. in the liquid; then 5.4 in. of this liquid equals 7.2 in. in water, and this liquid is as many times as heavy as water as 5.4 is contained in 7.2, or 1.33. We see that this liquid is 1.33 times as heavy as water. This wooden cylinder might be called a hydrometer, but those in actual use are made of a glass tube with a bulb at the bottom and a scale on the tube. The distance it sinks in water is usually marked 100 on the scale and this is divided by the distance it sinks in other liquids. Many hydrometers are made to suit the needs of special operators and their uses are very simple.

A LETTER TO YOUNG MEN.

MICHAEL DAWES.

"Wanted. Good, bright, intelligent American boys between sixteen and eighteen years old to learn the machinists trade; must have had a grammar school education or its equivalent. Apply to, etc."

MR. EDITOR:—This is the way I would advertise were I in need of boys to learn the machinist's trade. Perhaps I can give you a better idea of what I wish to say by stating some of the difficulties frequently experienced by manufacturing establishments in their efforts to obtain the right kind of boys, and if these few cold facts are brought to the attention of the fath-

ers through such a medium as I find AMATEUR WORK to be, it may be of advantage to some boy who hopes to better his condition. In parenthesis let me say that if the fathers only knew what wholesome, fascinating and interesting subjects, for both boys and men of a mechanical turn of mind, could be found within its covers, they would invest a dollar with you for a year's subscription. The result would be to encourage them to do something for themselves. I could continue writing commendatory things about your magazine, but the more I might write the further away I would be from what I started out to do, and that is to state how hard it is to get the right kinds of boys for trades; boys that will eventually develop into good men, masters of their chosen trade and capable of taking the positions of foremen, etc.

The man in charge of the apprentices is notified that an applicant is waiting. He finds a mother or a father with the son, and soon getting right down to business the questioning begins. The terms and conditions under which boys are taken having first been stated, "Why do you want to become a machinist?" "Have you ever worked anywhere?" "At what?" A glance at the boy's hands discloses that the fingers and thumbs are brown or yellow on the tips. "Do you smoke cigarettes?" An affirmative reply is given, the only answer that could honestly be made. This applicant is then told that, no matter how well qualified he was educationally, or how excellent his references might be, he would *not* be accepted, the interview ends, the disappointed parents leave, casting reproaches on the boy. "There, Johnnie! I wanted you to stop cigarette smoking, and that was the first thing the man inquired about." Too often the case.

Perhaps the next boy who applies does not use tobacco or liquors. He, also, is accompanied by a hopeful parent and has a school pin conspicuously displayed on his coat or vest. Yes, he graduated from the grammar schoool or went to the eighth grade. "Do you understand fractions, decimals and proportion?" "Yes, sir." And yet the boy is rejected. Why? Simply because, on examination, it is found that he cannot find the sum of a fraction and a decimal, nor can he convert a fraction into a decimal or *vice versa*.

Note that nothing is asked is as to his knowledge of grammar, geography or history; just a few simple questions in arithmetic. If the boy appears to be embarrassed he is given questions leading up to what is required, or he is left entirely by himself with paper, pencil and questions, and when he has had ample time in which to answer the questions he is again interrogated. Yet he fails, and what is his excuse? "I knew it at school." I say, "No, he did not." To illustrate: Ask that boy what is the sum of two and two; without hesitation he gives the correct answer. "Then you learned that at school?" "Yes, sir." Showing conclusively that what was learned was remembered. And this condition is found too frequently. Good, bright appearing boys apply and are rejected because they do not possess a thorough knowledge of common school arithmetic.

If the parents and the boy could only be impressed with the importance of this matter, the boy would not seek an opportunity to learn a trade without preparation, and I use the term generally now, as such knowledge is as necessary and applies as forcibly to the pattern maker's or the moulder's trade as it does to the machinists. Boys of sixteen, seventeen and eighteen years of age, and yet unable to solve simple problems from a common school arithmetic! Do they think a manufacturer has time to teach them arithmetic? If so they are greatly mistaken. If we are going to turn out young men who, after completing their apprenticeship are able to do the better grades of work as well as being capable of directing the work of others, we must insist upon their having a reasonable amount of education to begin with. The manufacturer of today has but little use for a boy of easy morals; it is the upright, manly, clean boy he is looking for. The positions now filled by the heads of different departments will eventually be filled by the capable and intelligent boys of today. The boy who frequents dance halls, billiard saloons, low theatres. or is addicted to the cigarette habit, need never expect to be chosen for any position of trust. We do not care to have him around.

He is not the boy wanted.

JOINTS IN WOODWORKING.

FRANCIS L. BAIN.

III. Mortise and Tenon and Dowelled Joints.

The style of joint to be used in door, sash and blind work and other work of a similar nature depends largely upon two factors, namely: thickness of material to be used, and purpose for which the completed work is to be used. For instance, if the stiles and rails of a heavy door were 1⅜ in. thick the use of dowels as the only means of joining would not be practical, as the unusually heavy strain and the constant moving of the door would eventually dislodge or weaken the dowels. On the other hand, if the frame for the door of a bookcase or wardrobe is being made, maple dowels are usually amply sufficient if properly glued in place, as the stock is so much thinner and lighter, thus relieving a great deal of the strain previously referred to.

In connection with the purposes for which the completed work is to be used, a good argument in favor of mortise and tenon joints can be derived from the consideration of a window frame with the constant jars and moving which many of them have. In this case the dowels would almost certainly become dislodged by the vibration, while the mortise and tenons would weaken very little, if at all. Dowels are, however, very commonly used in connection with this joint, being driven right through it from one side of the stock

From many true and tried suggestions concerning the two varieties of joints above referred to the following have been chosen as the most practicable and valuable:

Referring to Fig. 1. The distance *a* should never be less than the thickness of the stock *b*, as a lesser distance would weaken the stock at that point and perhaps cause a breaking out of the dowel later, or at least a fraction of the stock near the dowel.

A dowel should be inserted into each of the pieces it joins at a distance equal to at least twice its diameter, whenever possible.

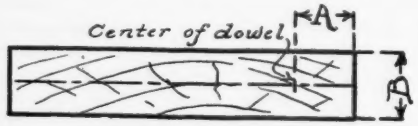


Fig. 1

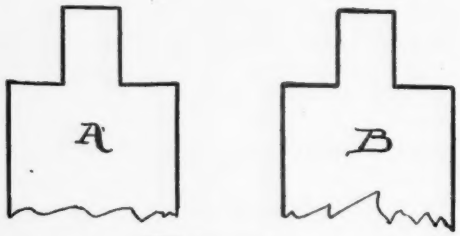


Fig. 2

The thickness of the tenon in a mortise and tenon joint should usually be one-third that of the stock from which it is formed, and the mortise should, of course, be a corresponding width. The shoulders of the tenon, properly made, should be exactly square across as shown at *B*, Fig. 2, but many amateurs find "chiselling to a line" rather irksome, and for the benefit of such a very slight concave is allowable, as shown at *A*, Fig. 2.

Unless joints are intentionally made to be taken taken apart, as in the case of halves of patterns, they should be thoroughly glued, as this adds 60 per cent. to the strength of the joint. Mortises and tenons should also be carefully glued, unless there is some reason for putting together without the gluing.

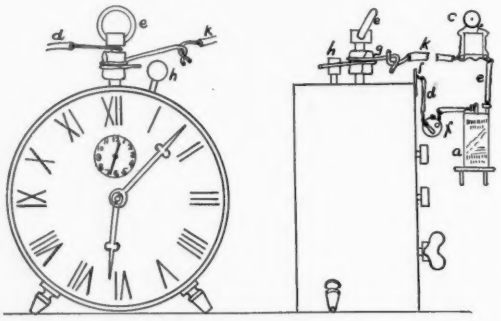
The next chapter will deal with the halved and dovetail halved joints.

It has been demonstrated that ground ivy and mustard can be destroyed through sprinkling with a solution of copperas (sulphate of iron), and that cereals are not injured by it.

ELECTRIC ALARM FOR CLOCK.

E. A. WHITE.

It will undoubtedly interest some of the readers of this magazine to know how to arrange an alarm clock so that it will close an electric circuit at the time at which the alarm is set to ring, and by this means sounding an electric bell in place of the alarm on the clock. A piece of pure copper wire of No. 14 or 16 gauge, about 4 in. long, and a piece of adhesive tape about 2 in. long are required, as well as a dry battery and common electric bell. Unscrew the ring *i* from the top of the clock and remove the gong, then replace the ring. Wind the piece of copper wire *g* two or three turns around the post, after covering the latter with adhesive tape, and twist the ends together so as to hold the wire and tape securely. Bend one or the free ends into a hook, to which attach a wire from the battery, and bend the other free end in the opposite direction so that it will engage the hammer that strikes the gong when the hammer moves.



If the clock is to stand on a shelf, connection is made from the switch *f* to the clock itself by placing the clock on a piece of sheet tin or brass to which the wire *d* is fastened, or by fastening this wire to the ring *i* at the top of the clock.

Put the battery and bell in a convenient place, and if the arrangement is to wake one up in the morning the switch *f* should be placed on the wall within reach of the bed. The writer has a nail driven in the wall near the bed on which the clock is hung by the small ring on the upper part of the back *b* and around which the wire *d* is wound. This makes contact with the clock itself, and when the clock is to be wound up it is only necessary to unhook the wire *e* and take the clock off the nail *j*. The switch *f* is placed beside the clock. The writer also has a switch placed on the wall beside to the other, a process which practically insures a double amount of strength at the joint.

the switch *f* so that by reaching out of bed and turning the switch the electric light in the room is turned on. The face of the clock can then be seen, being so near the bed.

The connections are as follows: One pole of the battery *a* is connected by the wire *b* with the bell *c* and another wire *k* connects the bell with the switch *f*; the end of the wire *d* from this switch is then made in the shape of a hook and can be easily hooked and unhooked to the wire *g* on the clock. The other pole of the battery *a* is connected to the ring *i* on the top of the clock, to the nail *f* on the wall or to the piece of tin on the shelf, according to the method followed in making connection with the metal part of the clock.

We will now suppose that it is desired to ring the bell at six o'clock. The alarm and time springs of the clock are wound up, the alarm hand set at the figure 6 and the switch *f* closed. When it is six o'clock the trigger, or hammer *h*, on the clock will spring forward and stay against the wire *g*, held by the alarm spring of the clock. This makes contact from the metal part of the clock to the wire *g* through the hammer *h*.

The circuit is thus completed and the bell will ring until the switch *f* is opened. To set the clock to ring again the hammer *h* is pulled back (it will not stay until about half an hour after the alarm has gone off) out of contact with the wire *g* and the switch *f* closed. Other apparatus instead of the bell may be operated at a certain time by means of the clock, by substituting that apparatus in place of the bell. The writer has used this arrangement for a long time to ring a bell and awaken him in the morning.

CORRESPONDENCE.

No. 84. CHICAGO, ILL., Sept., 1904.

In several published description of receiving instruments for wireless outfits, one side of the coherer goes to the aerial wire and the other side to the earth. One side of the sensitive relay goes to the hammer of the decoherer, which also connects by contact point to the ground side of the coherer. When the relay operates, the heavy battery works the sounder and at the same time the same battery shunts through the windings of the decoherer and operates that simultaneously. Now, in view of these conditions, I do not see how one can get anything else than "dots", for just as soon as the decoherer operates the relay opens and the sounder stops, and just as soon as the relay operates the decoherer works simultaneously with the sounder. Please tell me how such a system gives dots and dashes. I enclose sketch. J. R. B.

The circuit described is similar to several systems, among which is the Slaby-Arco, which is quite popular on both continents. The decoherer is a high-frequency hammer, as speedy as the quickest small vibrating bell mechanism. The stroke is adjustable. The magnets of the Morse sounder and the decoherer are connected in parallel and are wound to the same resistance.

The decoherer gives a sharp blow against the coherer, and the weak relay-coherer battery circuit is broken just before the blow is made upon the coherer.

When the resistance of the coherer filings is broken down the weak battery is permitted to operate the relay, which in turn closes a local and stronger battery through the sounder and decoherer at the same time. When this is done the decoherer armature is drawn down, but in so doing the weak relay battery is opened off of the decoherer hammer, the relay flies back, and the decoherer and sounder, because of the break in circuit at the relay contact, return to their normal position, and it is this upward stroke of the decoherer which restores the coherer to its high resistance. The electrical energy radiating from the sending aerial in the form of etheral waves is collected on the receiving wire in the form of an alternating potential and conveyed to the coherer. When this tension affects the coherer, the relay operates as described. The sounder and decoherer armatures start at the same time, and if the wave represents only a dot the sounder armature returns shortly after the decoherer acts. But while the decoherer is quick, the armature of the sounder is rendered sluggish by mechanical adjustments, which can be readily varied to suit, and when the series or train of interruptions representing a dash is being received the decoherer performs its function and springs back and forth many times before the sluggish armature of the sounder can rise. This feature presents itself most clearly in the operation of any inking device used in connection with the recording instruments."

TRADE NOTES.

DRILL WITH ADJUSTABLE TENSION.

Of all the automatic hand drills in the market up to the present time there has never been one that has been entirely satisfactory for general use. The trouble has been that no one strength of spring in these tools would be satisfactory in both soft and hard woods, or for the large and small drills furnished with the tool. The best that could be done was to use a spring of average strength.

In the new drill, No. 44, manufactured by North Bros. M'fg. Co. Philadelphia, Pa., this difficulty has been overcome by a device to adjust the tension of spring, making it weaker or stronger. The spring is

held at desired tension by a small bolt or lock which engages in the cap and is operated by a small knob on side of handle.

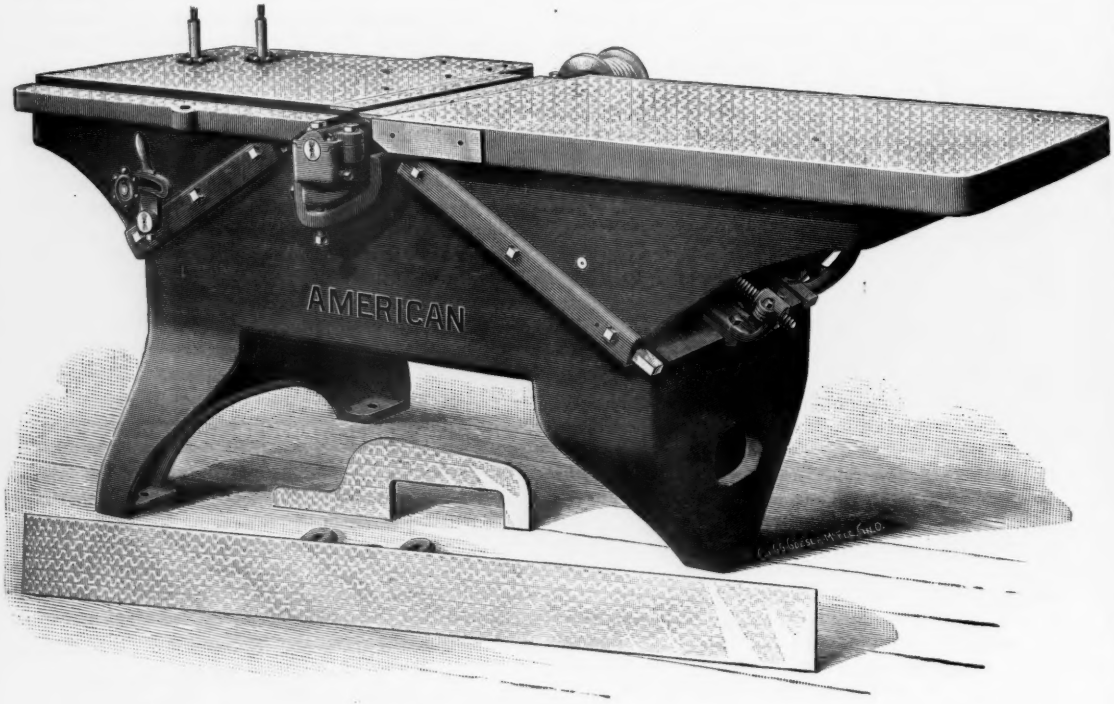
To adjust the spring pull down the bolt on side of handle, turn the cap on end of handle to the right for heavier tension for hard wood or larger driils, or to the left for soft woods or smaller drills. Turn cap, to hold it from turning while using the tool.

To open magazine in handle containing the drill points, hold the drill with the chuck end up, and unscrew nut above handle, and all the drill points will be in sight, thus enabling the user to quickly select and remove drill point required. To insert the drill points, hold the drill with chuck end up, turning sleeve on same to right as far as it will go. Insert drill point so that it catches at the bottom of chuck and will not turn, then turn sleeve to left until drill point is held solid.

The tool is nickel plated and finely finished, the materials and workmanship throughout being of the of the best.

Built to work 8, 12, 16, 24 and 30 in. wide, the adjustments, solidity and advantages of construction of this planer enable a wide range of work to be done upon it, such as squaring, smoothing, taking out of wind, glue jointing, bevelling, chamfering, rabbeting, moulding, tenoning, etc. It will also stick curved mouldings, such as casing heads, special inside finish mouldings, etc., which have heretofore been done by hand.

There are no links, wedges, pin joints or eccentrics under the table to get out of adjustment or wear slack; by putting the frame on three legs it is impossible to strain or twist it by bolting down or by the settling of the floor. By means of the large hand wheel at the right the working table can be moved instantly either way without requiring the operator to change his position in the least. The design and method of fitting up is such that the tables must be true and remain so, and they cannot twist, rock, strain or be displaced, no matter how uneven the foundations on which they are placed.



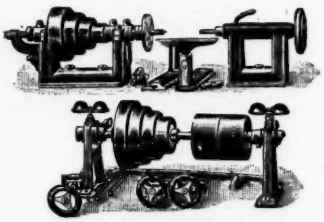
JOINTERS AND BUZZ PLANERS.

The accompanying cut illustrates the latest improved new pattern machine, manufactured by the American Woodworking Machinery Co. It has been made heavier and stronger, and with the improvements is the best machines of its class on the market.

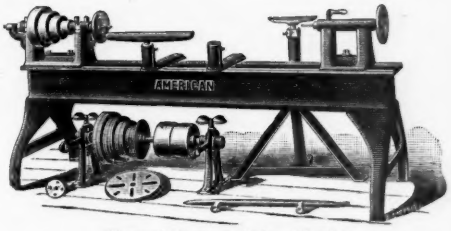
The several salesrooms of the company are as follows: 136 Liberty Street, New York City; 43-45 So. Canal Street, Chicago, Ill.; Hennen Building, New Orleans, La., and 145 Oliver Street, Boston, Mass.

The new moters and dynamos of Kendrick & Davis, Lebanon, N. H., are fine machines.

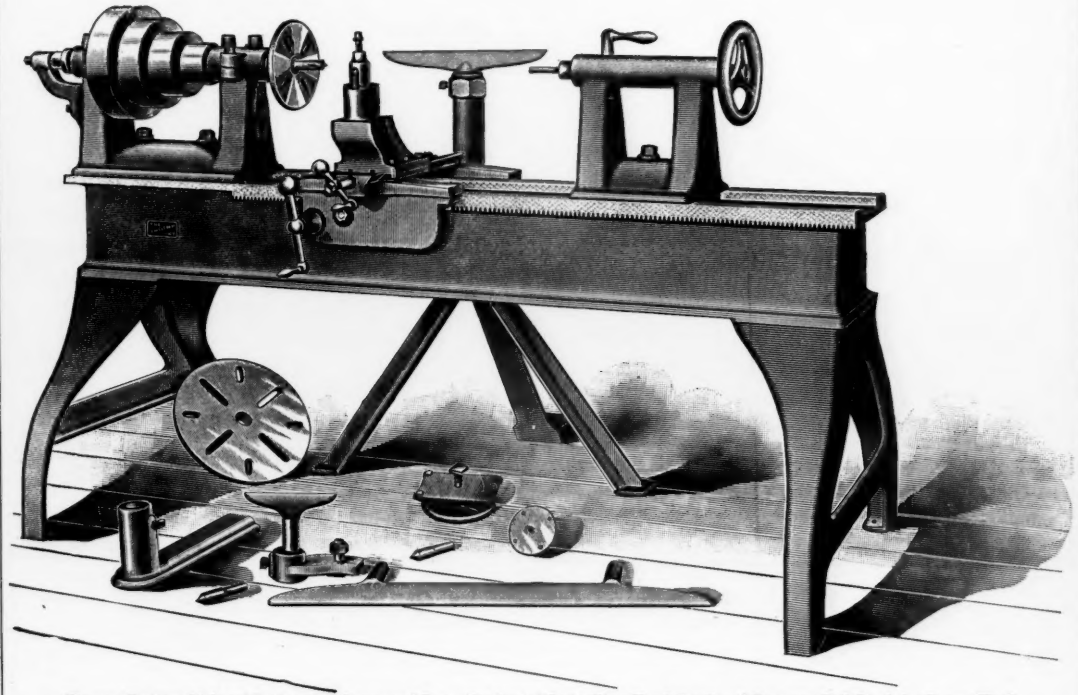
PATTERN MAKERS' LATHES



Clement Pattern Makers' Lathe.



Clement Pattern Makers' Lathe.



Clement Pattern Makers' Lathe with Compound Rest, Graduated Swivelling Head Stock and Set-over Tail Stock for Taper Work.

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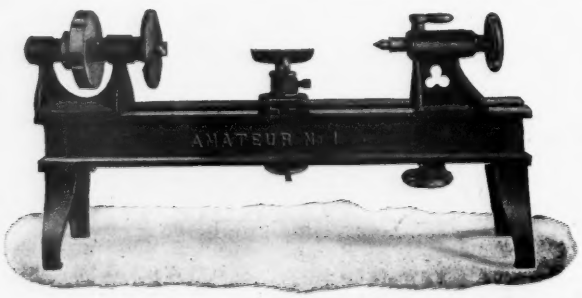

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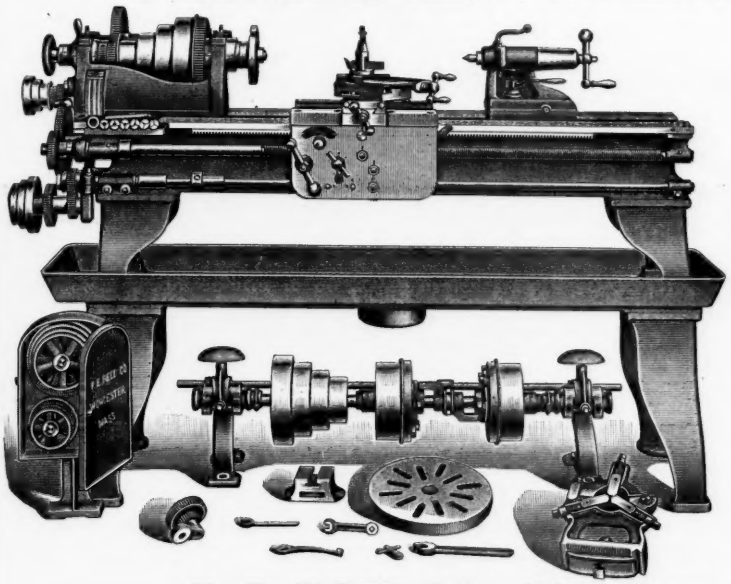

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The illustration shows the 12″ Engine Lathe made by

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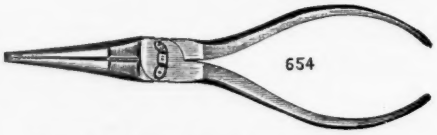

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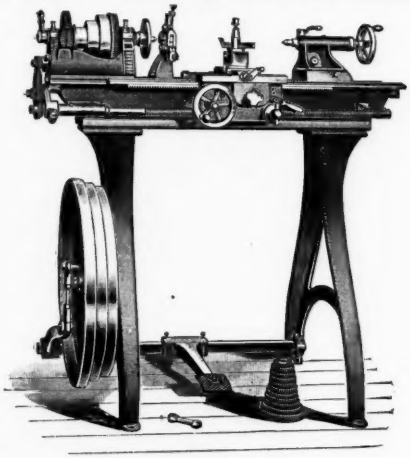

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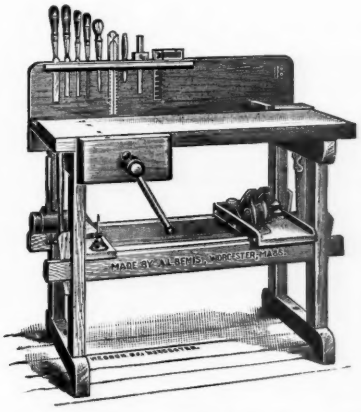

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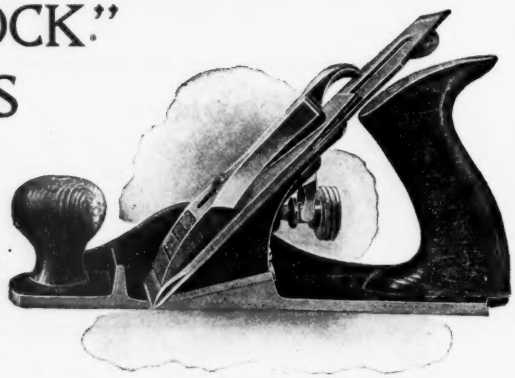

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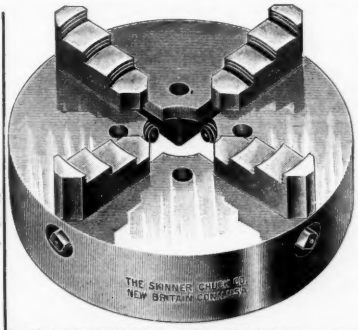

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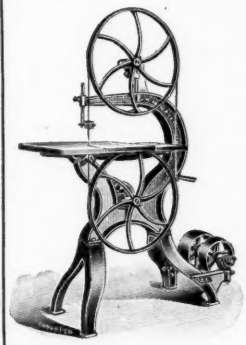

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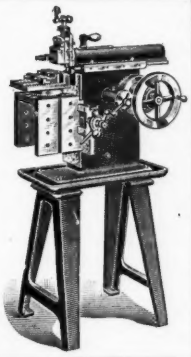

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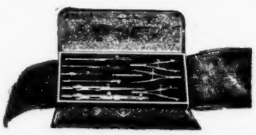

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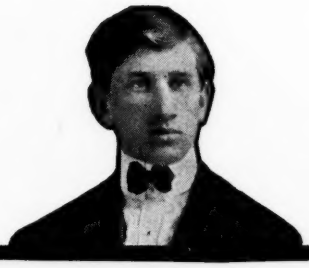

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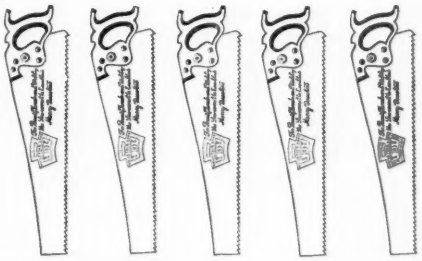

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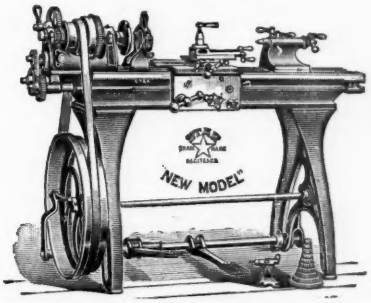

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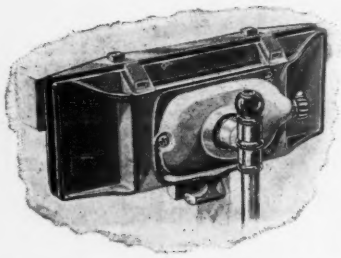

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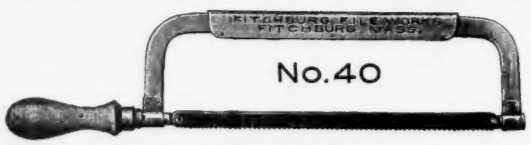

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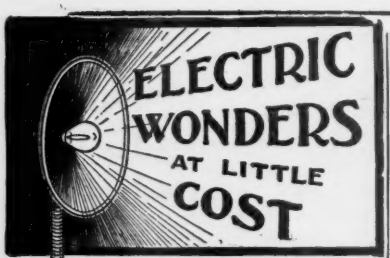

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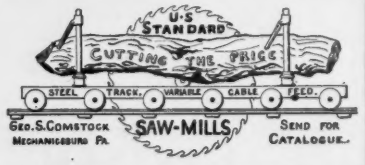

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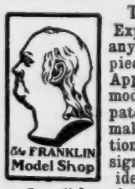

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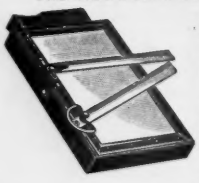

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